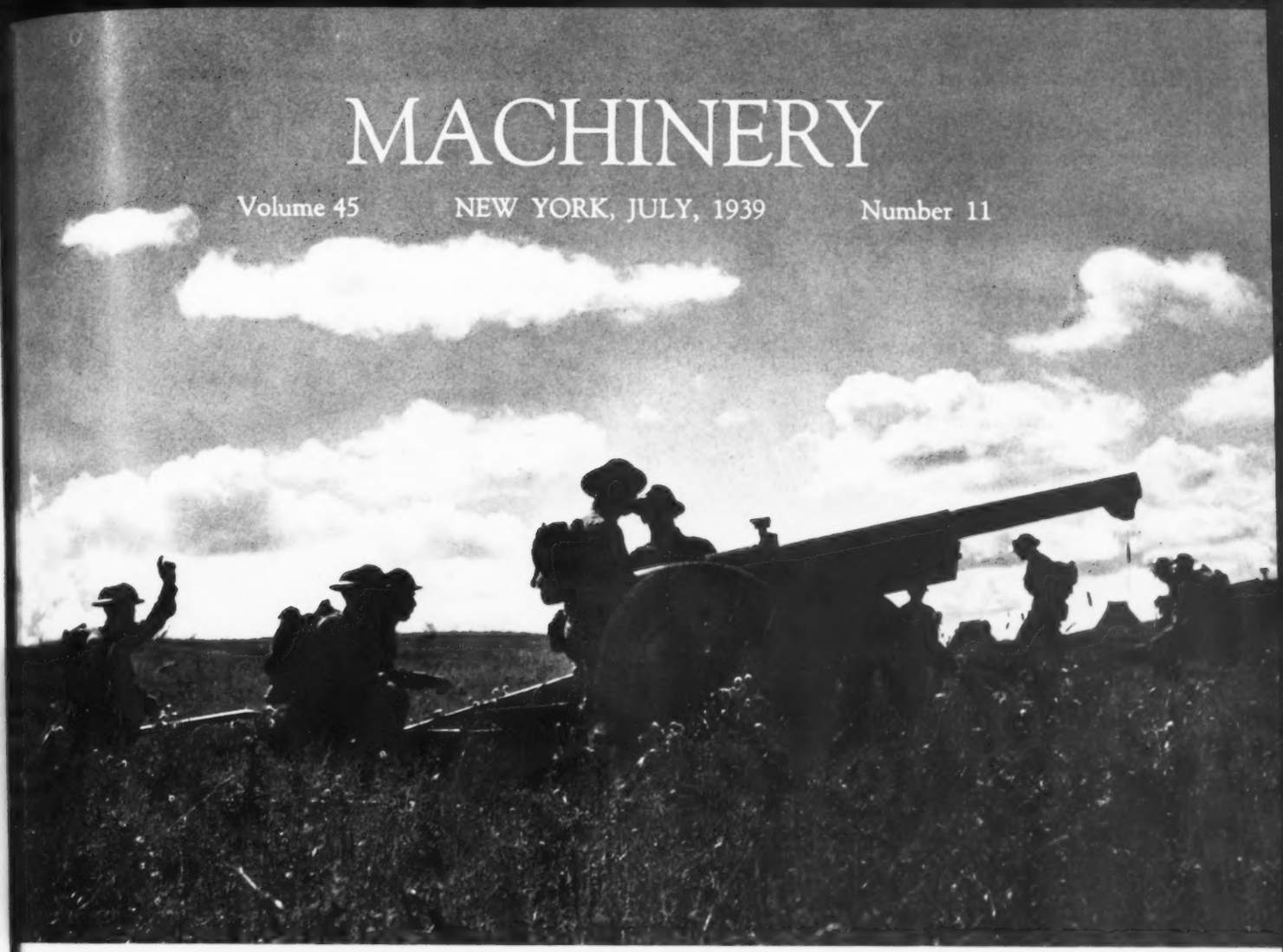
MACHINERY

Volume 45 NEW YORK, JULY, 1939 Number 11



# *Adequate National Defense Requires Modernized Army Arsenals*

*By MAJOR GENERAL CHARLES M. WESSON*

*Chief of Ordnance, The United States Army*

THE manufacturing arsenals of the United States Army are charged with the important responsibility of developing during peacetime the most efficient methods of producing the munitions of war and of training a highly capable inspection personnel. They are expected to overcome any production difficulties in the design of Army equipment and establish a high manufacturing technique that can serve as a standard for private concerns who may be awarded contracts to manufacture similar items. The arsenals are also expected to be so efficiently organized that they can produce economically in competition with private manufacturers. In case of a national emergency, many private industrial plants should be able to manufacture munitions without material loss of time by merely adopting the proved arsenal methods.

In order to perform these functions satisfactorily, it is absolutely necessary that the arsenals be equipped with the most modern machine tools. High production by present-day standards cannot

be attained with machines built during and prior to the World War, nor can antiquated equipment be expected to machine parts to high accuracy.

During the last four or five years the arsenals have spent several million dollars for new machine tools that were badly needed for replacement purposes or to tool up for the production of such new fighting equipment as the semi-automatic rifles and anti-aircraft guns. That this money has been wisely expended will be apparent from the following articles in this number of MACHINERY. In some instances on repetitive work, manufacturing costs have been reduced as much as 50 per cent by the installation of new machine tools.

Unfortunately, however, a great proportion of the machine tool equipment in our arsenals is obsolete and must be replaced before the arsenals will be fully capable of carrying out their duties. A recent survey showed that 84 per cent of the machine tool equipment in one arsenal is over eighteen years old, and there are quite a few ma-machines having an age of forty years. Machines that old are not sturdy enough for the satisfactory application of carbide tools, are not provided with hydraulic drives for speedy production in certain operations, and do not possess other mechanical features that would be advantageous to arsenal production activities.

The survey indicated that an expenditure of about $16,000,000 would be required to modernize the machine tool equipment of arsenals to a point where it would be comparable to that of progressive metal-working plants in private industry. Appreciating the fact that national safety depends largely on efficient arsenals, the present session of Congress has seen fit to appropriate $6,000,000 to be expended for new arsenal equipment during the fiscal year just starting—July 1, 1939, to June 30, 1940. This money will be spent entirely for machine tools and equipment for the rehabilitation of production facilities, and will be proportioned between the arsenals on approximately the following basis: Frankford, $975,000; Picatinny, $375,000; Rock Island, $1,425,000; Springfield, $1,125,000; Watertown, $1,350,000; and Watervliet, $750,000.

Also, Congress has granted permission for the arsenals to barter old machines of a given kind for new machines of the same type. As an example, six or eight lathes that are no longer useful in arsenals may be traded for one up-to-date lathe.

The new machine tools will be selected largely on the basis of their ability to produce the parts of such recent developments as 37-millimeter anti-aircraft and anti-tank guns; 8-inch railway guns and mounts; 105-millimeter howitzers; tanks; scout cars; 60- and 81-millimeter mortars; and semi-automatic rifles. In preparation for the purchase of the new machine tools, suggestions from the equipment builders as to how the various munition components can be best machined are welcome. Generous cooperation of this kind led to the intelligent selection of the equipment recently installed at the Springfield Armory for the manufacture of semi-automatic rifles; at the Frankford Arsenal for the production of artillery shells; and at the Watervliet Arsenal for the building of anti-air-

craft guns. The Ordnance Department is deeply appreciative of such liberal exchanges of ideas.

In addition to the program of machine tool rehabilitation outlined for the present year, about $2,000,000 will be expended for special equipment, such as barrel and gun rifling machines, powder presses, and other types of machinery not ordinarily used by commercial concerns. This machinery will be purchased as a war reserve under a plan that calls for the expenditure of about $25,500,000 in the coming years, of which $4,225,000 was appropriated for the fiscal year 1939.

The munitions of war are far more difficult to produce today than they were during the World War because of the much greater variety, but, equipped with up-to-date machine tools, our arsenals will be able to set up efficient production standards and eliminate the manufacturing confusion unfortunately so prevalent in 1917, largely because our arsenals at that time were outfitted with machine tools that dated as far back as the Civil War. *National safety can be assured only by national preparedness and that necessitates modernized Army arsenals.*

Arsenals should be considered solely as laboratories for carrying on and developing the art of manufacturing munitions. In time of a major war, they would be able to produce only about 10 per cent of actual requirements. It is for this reason that the War Department has developed the Industrial Mobilization Plan, under which educational orders to the amount of $32,000,000 will be placed with private industrial plants to prepare them for munition manufacture in case of a national emergency, if the program now before Congress is approved. The following articles will give manufacturing plants soon to receive these educational orders considerable information as to the types of modern machine tools being used in arsenal operations and indicate the high-grade workmanship necessary in munition manufacture.

These articles emphasize the close tie-up between arsenals and the machine tool industry. *Without machine tools, there could be no arsenals, and without the latest types of machine tools, arsenals would be woefully handicapped in carrying out their prescribed functions.* As Chief of the Ordnance Department whose responsibility is to provide our troops with practically every type of offensive and defensive weapon required by them, it is my earnest wish to place our arsenals on the highest possible plane of manufacturing efficiency.

*MAJOR GENERAL CHARLES M. WESSON*

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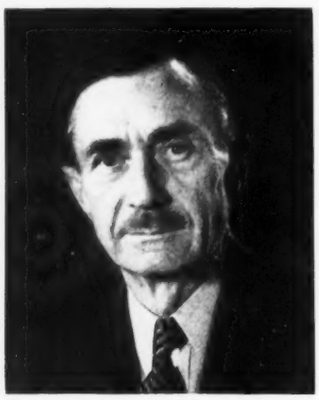
*Major General Charles M. Wesson was appointed Chief of Ordnance on June 3, 1938. General Wesson was appointed to the West Point Military Academy on June 15, 1896 and upon graduation in 1900, was commissioned a Second Lieutenant of Cavalry. He was promoted to First Lieutenant of Cavalry in 1901; Captain, Ordnance Department, in 1907; Major, Ordnance Department, in 1911; Lieutenant Colonel of Cavalry in 1917; and Colonel, Ordnance Department (temporary), in 1918. He resigned in 1919.*

*General Wesson accepted appointment as Major, Ordnance Department, in 1920, was promoted to Lieutenant Colonel in 1923 and to Colonel in 1933. He received his present rank of Major General upon appointment as Chief of Ordnance in 1938.*

*General Wesson was awarded the Distinguished Service Medal for his "indefatigable energy, great administrative ability, and thorough technical knowledge" in planning and erecting a factory for the manufacture of howitzer carriages and a forging plant for large-caliber guns, and in salvaging millions of dollars of ordnance material at the end of the World War. He also received the French Order of the Black Star.*

# *Springfield Armory Tools Up*

*By COLONEL GILBERT H. STEWART, Commanding Officer*



*Colonel*
*Gilbert H. Stewart*
*United States Army*

RIFLES for every war fought by American soldiers, with the exception of the Revolutionary War, have been produced in the historic United States Armory at Springfield, Mass. This is the oldest of the Army manufacturing establishments, having been started in 1794 on a site selected by George Washington in 1777.

Manufacturing facilities in the Springfield Armory have, of course, undergone great changes since the early days. In past years, money for new equipment was made available only during war times, and so when a war broke out, the rifles were necessarily manufactured by methods that had been developed during the previous war, twenty or more years earlier.

The present period can therefore be considered unique in the long history of the Armory, because a considerable sum of money has been made available for the purchase of machine tools during a peacetime period. Part of this money ($1,800,000 during the fiscal year just ended) is being applied for the purchase of machinery to manufacture on a real quantity-production basis the new U. S. caliber 0.30 M1 rifle (Garand semi-automatic). An additional $500,000 was made available during the last fiscal year for machinery to produce barrels for the recently developed caliber 0.50 machine gun. The machinery for the latter purpose is temporarily set up at the Springfield Armory, but will be available in time of war for transfer to commercial plants.

In determining upon the machine tools to be purchased and the methods to be applied for manufacturing the new rifles and barrels, engineers of wide practical experience in the metal-working fields were consulted, with a view to devising methods comparable to the best practice followed in private industry. Practically all the new equipment consists of standard machine tools. Most of the machines could be employed in the regular manufacturing activities of industrial plants that have accepted schedules under the Industrial Mobilization Plan, and used for the production of rifles or other munitions if mobilization day ar-

# *for New Semi-Automatic Rifles*

rived. Interesting operations performed on many of the new machine tools will be described in this article.

New equipment has been installed for performing most of the operations on the barrels of the semi-automatic rifle and the caliber 0.50 machine gun. Fig. 1 shows the first operation on a semi-automatic rifle barrel, in which the barrel is cut accurately to length in a Fay double-end automatic, which also center-drills the two ends. For this operation, the stock is located lengthwise in V-blocks on the work-holding units by a finger-stop on the headstock. The work is automatically clamped in the V-blocks by the operation of two motor-driven screws. The work-holding units are adjustable longitudinally on a bar in the center of the bed to suit the length of the barrel being handled.

After the rifle barrel has been clamped, the work-holding units are rocked toward the back of the machine to carry the ends of the barrel past two milling cutters. The work-holding units then rock forward to bring the barrel in line with two centering and countersinking drills, as shown. These drills automatically advance to the work and return, after which the work clamps are released. The rifle barrels reach this machine approximately 1/4 inch too long, and are milled to the desired length within 0.010 inch.

The next operation on the rifle barrel is to grind a cylindrical surface near the middle for holding it accurately in succeeding operations. Then the butt end is rough-machined in a standard Fay automatic lathe, equipped with seven cutters on the carriage at the front of the machine for taking a series of turning cuts, and with two cutters on the back arm for facing.

The rifle barrel is then transferred to another Fay automatic lathe, equipped as shown in Fig. 2, which rough-machines the muzzle end; this illustration shows the barrel for a caliber 0.50 machine gun. Five tools on the front carriage take turning cuts simultaneously, the tools being fed at an angle in order to obtain the desired taper. At the beginning of the operation, the first cutter from the right-hand end of the carriage takes a cut 3/8 inch deep in the tough chromium-molybdenum steel.

Two cam-operated roller type steadyrests support the work during the heavy turning cuts. The two rollers on the left-hand steadyrest are first brought

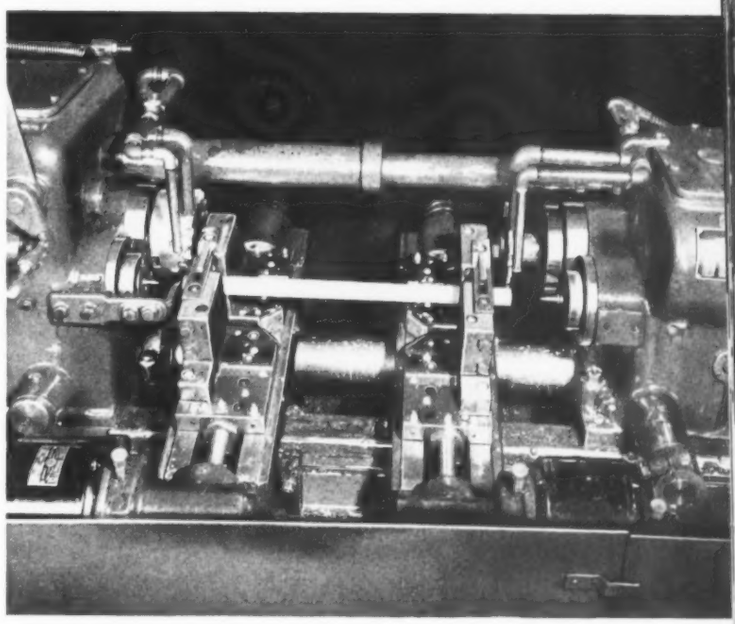
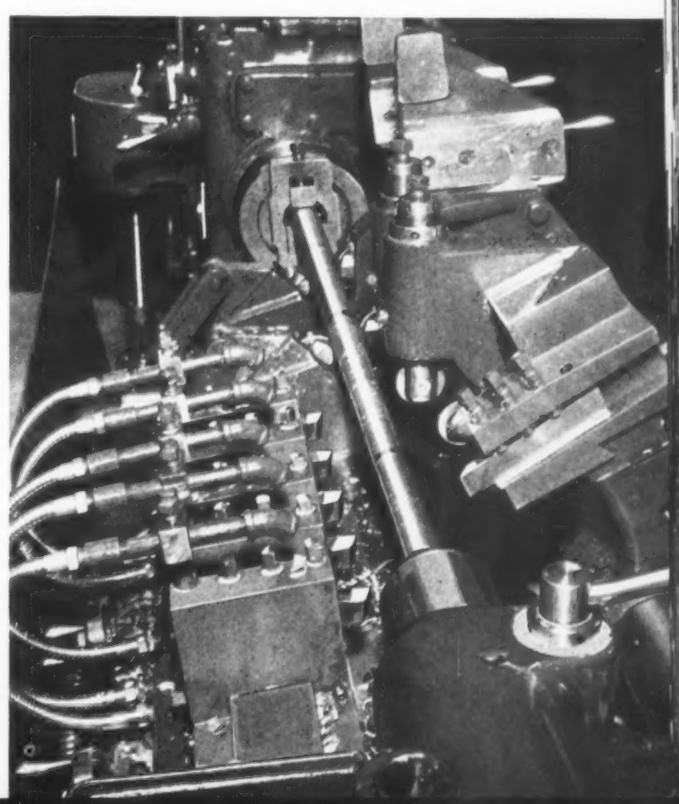


*Fig. 1. Milling Rifle Barrel Stock to the Specified Length within 0.010 Inch, and Center-drilling and Countersinking the Barrels in the Same Operation*

*Fig. 2. Fay Automatic Lathe Tooled up for Rough-turning Barrels for the Caliber 0.50 Machine Guns. Cuts up to 3/8 Inch being Taken on the Tough Material*



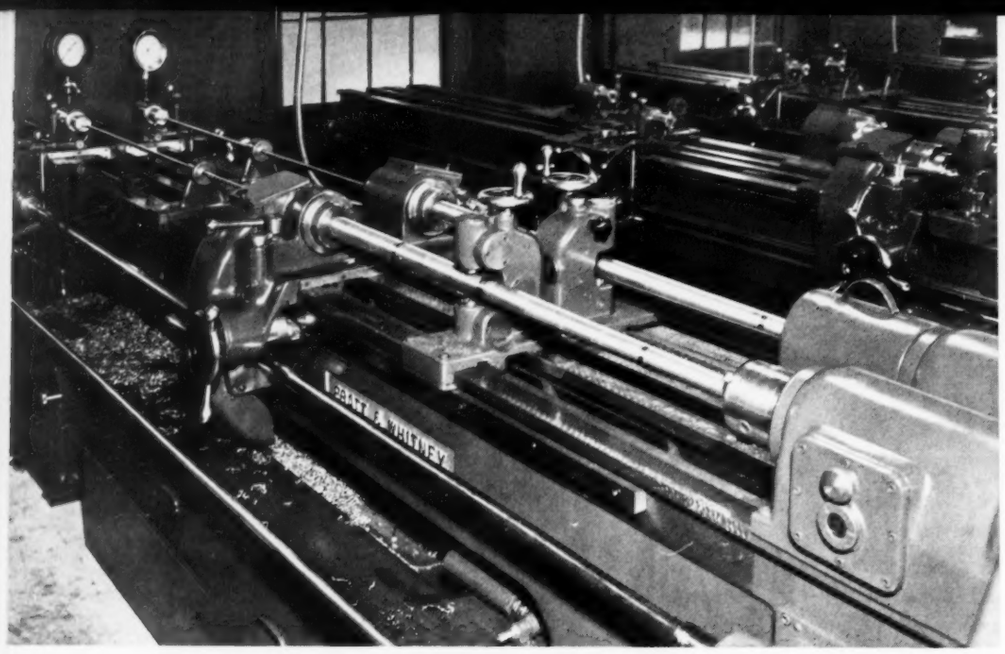



*Fig. 3. Modern Design of Barrel Drilling Machine Installed for Drilling the Caliber 0.50 Machine Gun Barrels on a Real Production Basis*

into contact with the previously ground barrel surface. However, when the barrel has been turned past the right-hand steadyrest, the rollers of this rest are brought into contact with the turned surface for supporting the barrel during the turning of the ground portion to the required diameter. While the turning cuts are in process, the back arm rocks forward to chamfer the muzzle end. The rifle barrels are also finish-turned in Fay automatic lathes, twelve machines of this type having been installed in the recent re-equipping of the barrel department.

Twelve Pratt & Whitney barrel drilling machines of the advanced design shown in Fig. 3 have been installed for drilling the caliber 0.50 gun barrels. These machines are designed for drilling two barrels at a time from the breech end. Another feature of the new machines is the method of supporting the chamfered muzzle end in the dished seat of a female center mounted in the carriage unit, which revolves in anti-friction bearings.

Drilling is performed as the 6-foot single-fluted stationary drills are fed forward by the carriages at the rear end of the bed. Oil at a pressure up to 700 pounds per square inch is forced through a hole in the center of each drill to wash chips out of the gun bore along the drill flute. This operation is performed at the rate of about 1 1/8 inches a minute, the gun barrels being 45 inches long. At the end of the operation, the bores must be straight and concentric within close limits.

Rifling of the caliber 0.50 barrels is performed, after a reaming operation, on Ex-Cell-O machines of the type shown in Fig. 4, twenty of these machines having been purchased. Two barrels are rifled at a time by tool-bars attached to the hydraulically actuated carriages. The rifling bars are rotated to produce the desired helix as the lead-screws seen at the left, to which the cutter-bars are connected, are pushed past stationary heads equipped with rollers that engage the threads of the lead-screws.

One groove at a time is machined to a depth of about 0.0003 inch with each stroke of the rifling tool. Upon the completion of each stroke, the barrel is indexed by the mechanism at the right-hand end of the bed, in order to cut eight rifling grooves around the barrel bore. When all the grooves have been machined to the same depth, the small hook type cutter bit is fed upward 0.0003 inch in the bar,

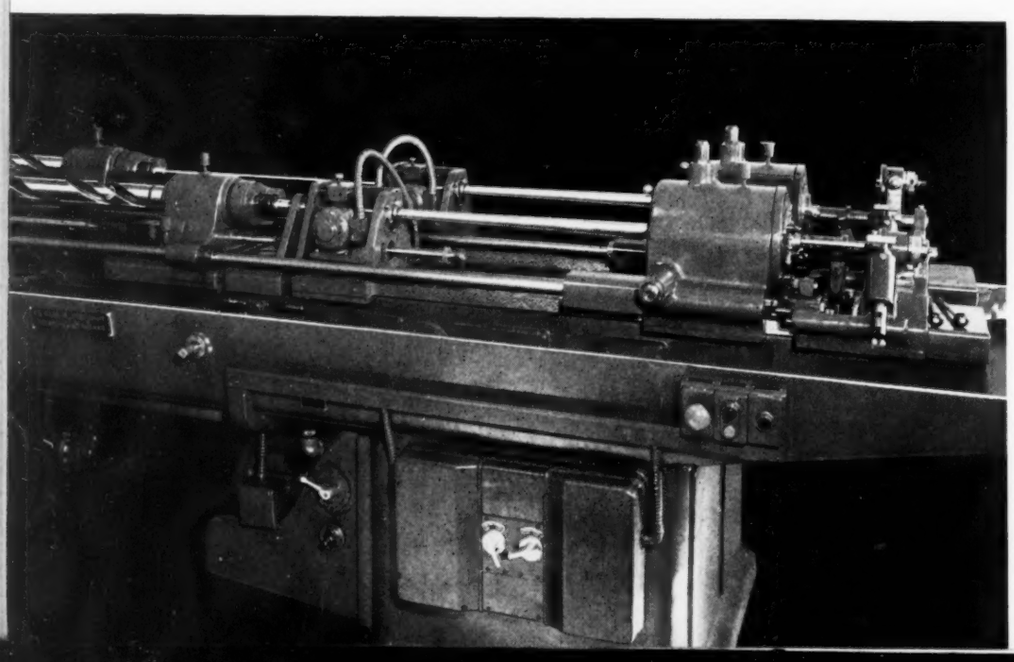


*Fig. 4. New Type of Hydraulically Operated Rifling Machine that Rifles Two Barrels Simultaneously. To Complete the Job, 160 Reciprocations of the Rifling Bars are Necessary*

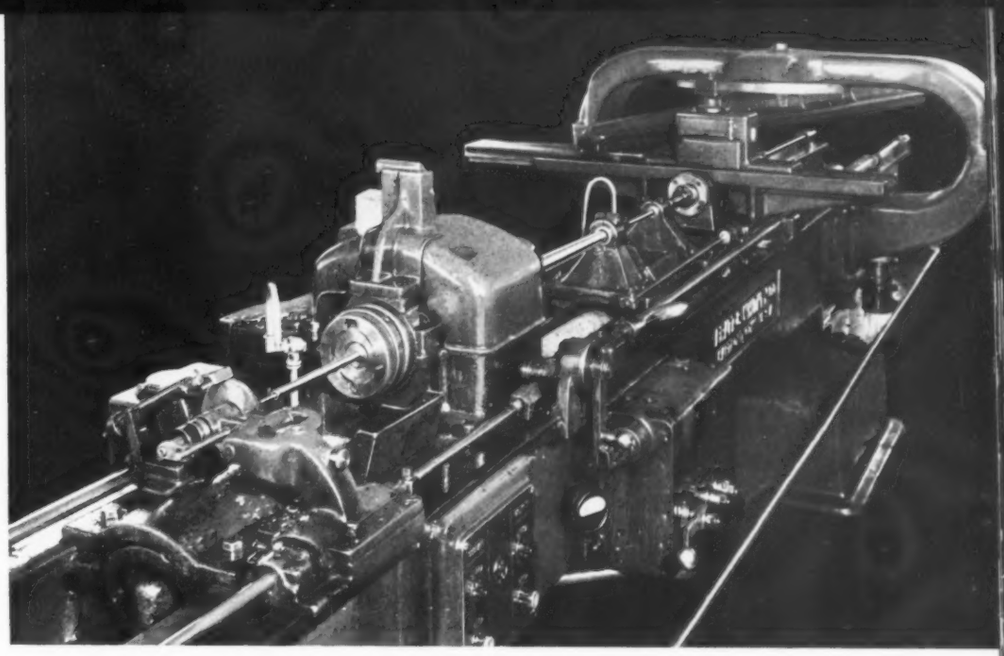


*Fig. 5. Another Type of Rifling Machine Fitted with a Sine Bar that Enables Quick Changing of Helix Angle to which Gun Barrels are Rifled*

and the process is repeated. About twenty cuts must be taken in each groove, necessitating about 160 reciprocations of the rifling bar in order to complete one barrel. The machine is hydraulically operated, and a barrel can be rifled complete in approximately 60 minutes.

Each cut is taken during the draw stroke of the cutter-bar, and the cutter bit is automatically depressed for the return of the bar through the rifle bore. The rifling bar closely fits the barrel bore. Each time that the rifling tool is withdrawn from the barrel it passes over a motor-driven brush in the unit that supports the left-hand end of the barrel, so as to clean off all chips from the cutter.

Barrels for the semi-automatic rifles are rifled on Pratt & Whitney machines of the type illustrated in Fig. 5, which are designed with a sine-bar arrangement, by means of which any desired rifling helix can be readily obtained. It is merely necessary to change the angle of the sine bar in order to vary the twist of the rifling bar. In this machine, the barrel is also indexed between strokes by the mechanism at the front end.

The hobbing of a thread, and of a plain cylindrical surface in front of the thread, on the breech end of the rifle barrel, are accomplished simultaneously in the Hanson-Whitney thread milling machine illustrated in Fig. 6. The tolerance on the plain diameter is only 0.001 inch, while a tolerance of 0.0045 inch is allowed on the pitch diameter of the threads, of which there are twenty per inch. The long rifle barrel is inserted into the chuck through the hollow headstock spindle. The operation is completed with one revolution of the work.

Threads are milled on the breech end of caliber 0.50 barrels in the Hall Planetary thread milling machine shown in Fig. 7. Ten cutter buttons within the head of this machine cut the threads to the required pitch diameter within 0.0033 inch.

The next important step in the production of rifle barrels consists of roughing and finishing the chamber. Six cutters, mounted on the multiple head of a Pratt & Whitney machine of the type shown in Fig. 8, are used for the roughing cuts, and eight for finishing. Reaming, counterboring, countersinking, and chamfering cutters are indexed successively into line with the barrel bore, and then fed along the barrel to the required depth. The various surfaces must be true to the specified diameter and length within plus or minus 0.0005

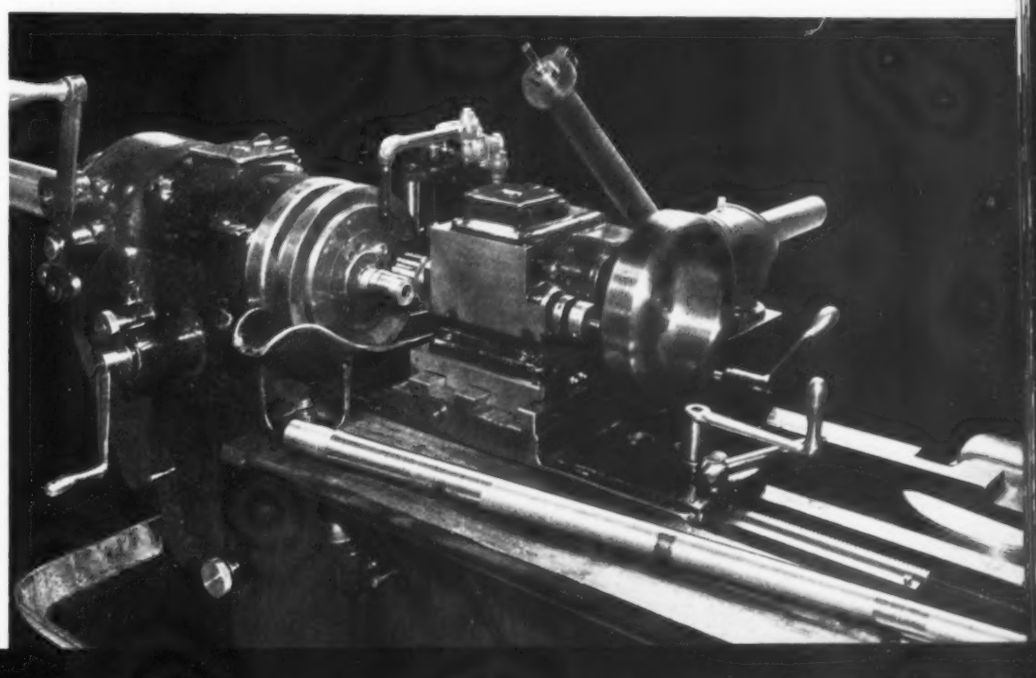


*Fig. 6. Hobbing a Thread on the Breech End of a Gun Barrel, and at the Same Time Finishing a Plain Cylindrical Surface in Front of the Thread to a Required Diameter with One Tool*

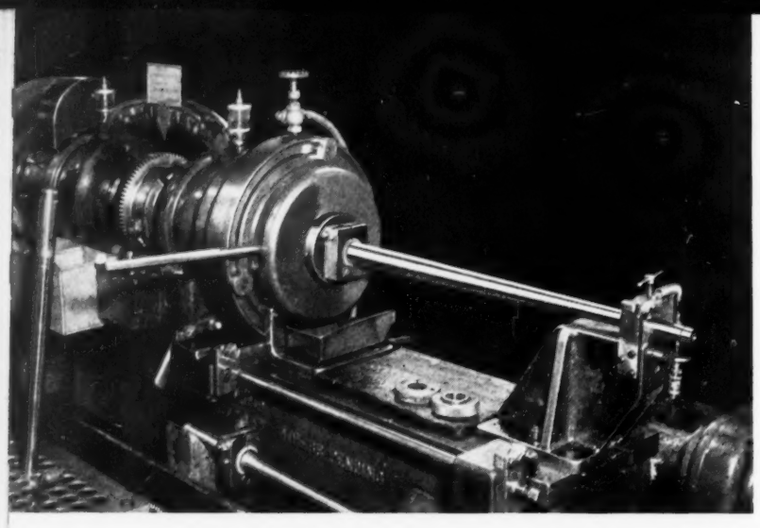


*Fig. 7. Hall Planetary Thread Milling Machine Set up for Cutting an External Thread on the Breech End of Rifle and Machine Gun Barrels*

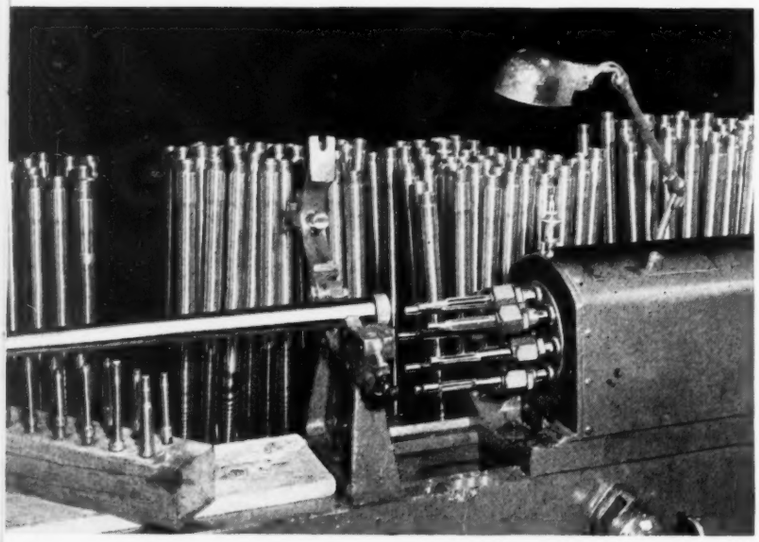


*Fig. 8. Chambering of Rifle and Machine Gun Barrels is Accomplished by Using Successively a Number of Tools Mounted on an Indexing Head*

inch. All the gages seen in the block on the bed of this machine are employed for inspecting the finished chamber.

Forty serrations are hobbed around the breech end of these barrels by the Barber-Colman machine shown in Fig. 9. The work is slipped into the collet chuck through the left-hand end of the hollow work-spindle, and is located lengthwise by a bar gage, placed between the end of the work and the center held in the bracket suspended from the over-arm of the machine.

Four Lapointe broaching machines have been installed for finishing intricate outlines on rifle receivers and for broaching eight rifle apertures in a ring that is later cut up into segments. The ring broaching operation is shown in Fig. 11. On the left-hand way of the bed is seen a ring as it appears before the operation, and on the right-hand way one of the broached rings. Stock to a depth of 1/4 inch is removed with one stroke of the 4-foot broach, the diameter of the hole at the beginning of the operation being 3 1/2 inches. These rings are ground on both faces before coming to the broaching operation, so as to insure accurate seating in the work fixture of the broaching machine. The tolerance allowed on all surfaces of these parts is 0.002 inch. This machine is also used for broaching a variety of other parts. It operates

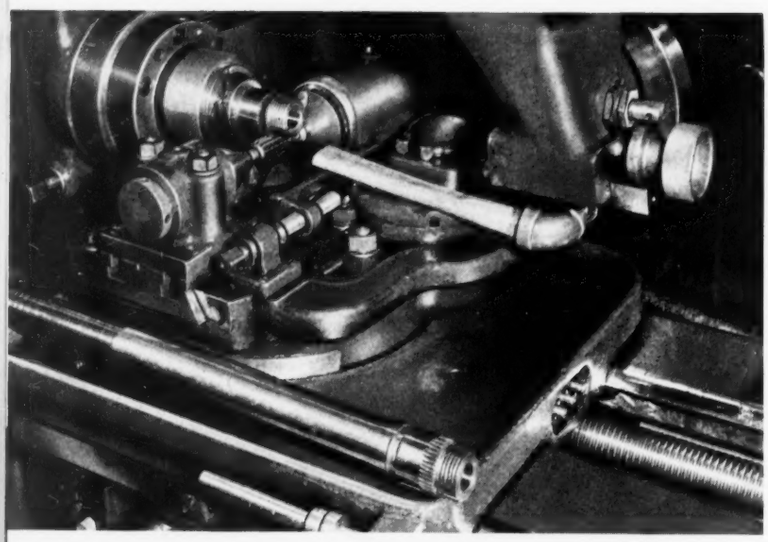


*Fig. 9. Hobbing Forty Serrations around the Breech End of a Machine Gun Barrel within Close Limits of Accuracy as to Specified Spacing*

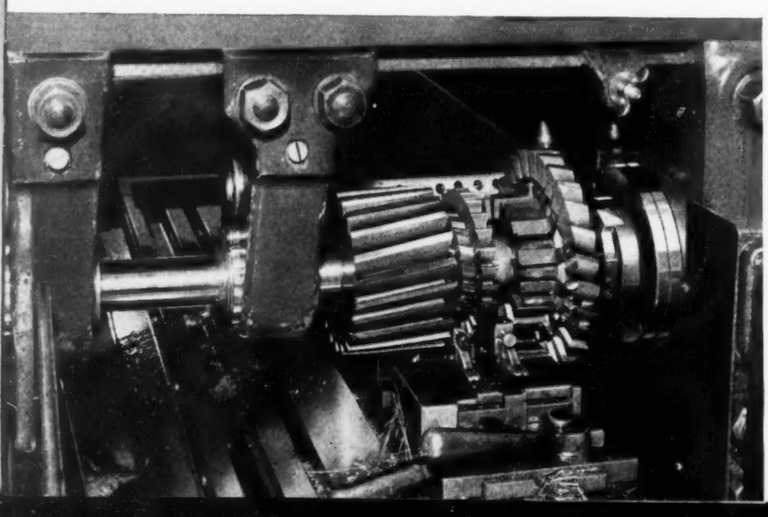


*Fig. 10. An Automatic Milling Machine Equipped with Seven Cutters for Taking a Series of Cuts Simultaneously on Rifle Receivers*

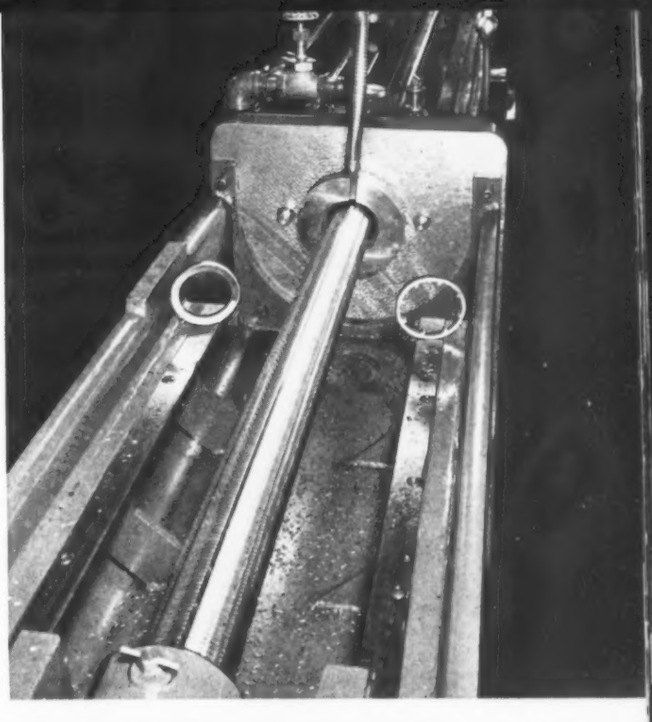


*Fig. 11. Broaching Machine with Tool Used to Cut Internal Teeth in Rings that are Later Cut up for Use as Rifle Apertures*

at a hydraulic pressure of approximately 1000 pounds per square inch.

The tooling provided on a Cincinnati 36-inch automatic milling machine for an operation on receivers is shown in Fig. 10. Seven cutters take a series of form-, straight-, and face-milling cuts simultaneously.

A Brown & Sharpe universal milling machine is seen in Fig. 12 finishing a narrow slot in a rifle part. In this operation, the table is fed toward the cutter for milling one side of the slot until the closed end of the slot is reached, at which point the circular work-table is revolved through 180 degrees for milling the closed end of the slot. Then the regular table of the machine is once more fed in a straight direction to feed the second side of the slot past the cutter. A dial gage on the head of the machine is used to position the cutter accurately for height relative to the work fixture, while the dial gage seen at the left-hand end of the table indicates the point at which the table movement is to be stopped for the rotation of the circular table.

Thirty new Pratt & Whitney profile milling machines of the type shown in Fig. 13 have been installed for finishing intricate contours on a large variety of rifle parts. The operation shown consists of milling an irregular groove in ferrules, such as seen at the front of the table. Roughing and finishing cuts are taken. In each step, a tracer at the right of the cutter is moved around the outline of a slot in a templet mounted at the right of the work fixture. Tolerances range from 0.001 to 0.004 inch. Twelve Newton profilers have also recently been installed for operations on receivers and other rifle parts concerning which all information is restricted.

A second installment of this article, featuring additional operations in the Springfield Armory, will be published in a coming number of MACHINERY.

*Fig. 12. An Intricate Milling Operation on a Rifle Part Performed on a Universal Milling Machine Equipped with Dial Gages that Facilitate Accuracy*

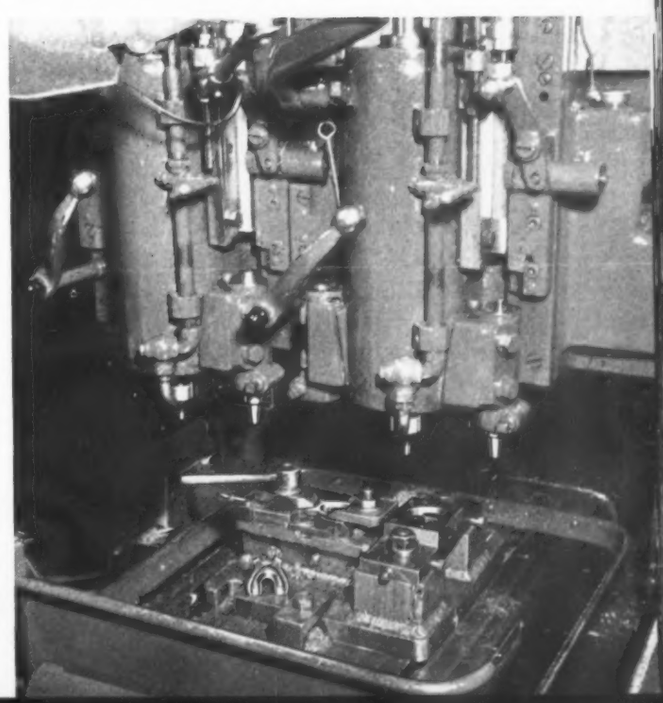
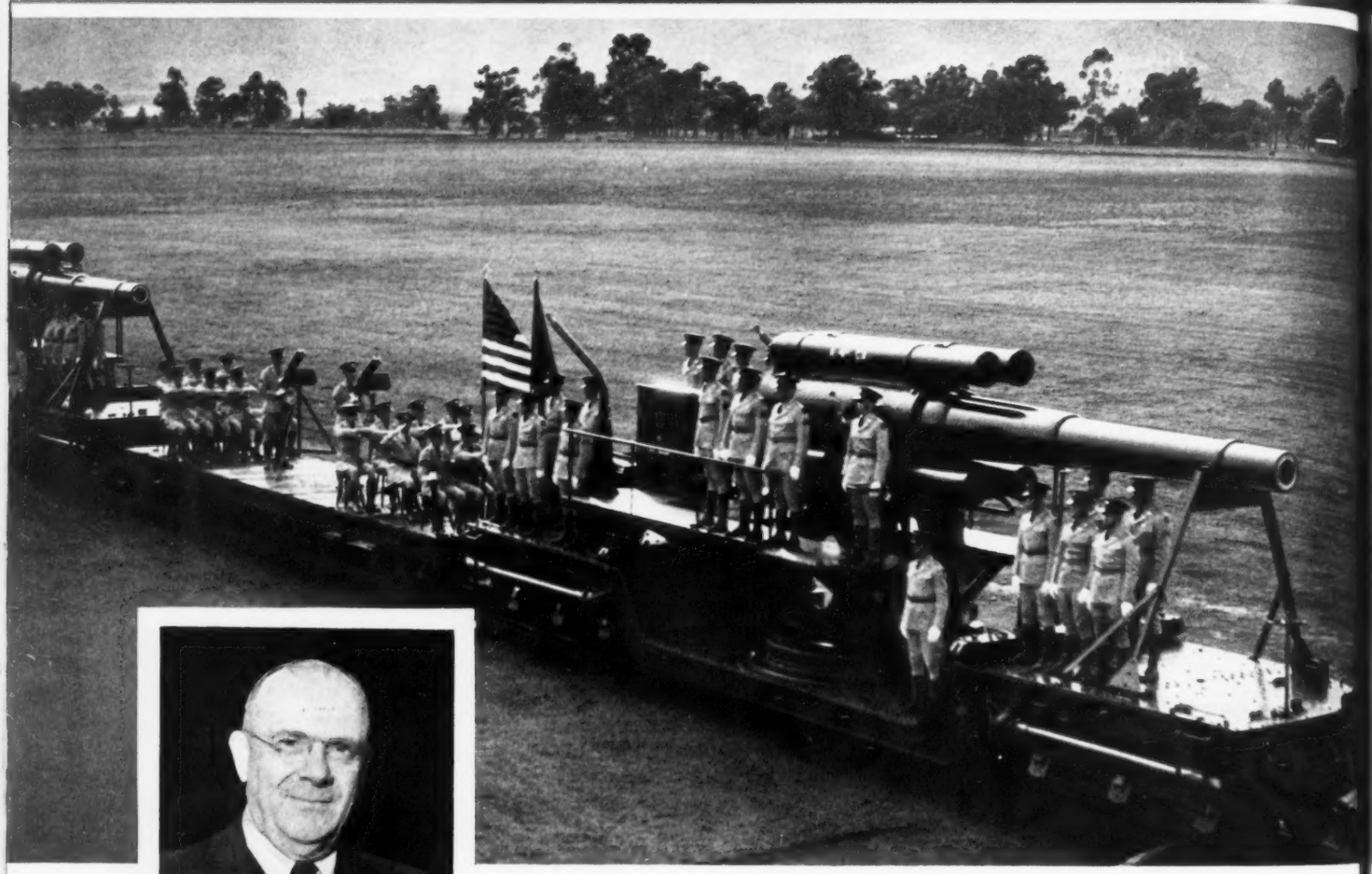


*Fig. 13. One of a Large Number of Profile Milling Machines. The Operation Here Shown Consists of Roughing and Finishing a Groove in Rifle-stock Ferrules*

# *The Army's Big Guns Are Made at*



*By COLONEL RICHARD H. SOMERS, Commanding Officer*
*Watervliet Arsenal, Watervliet, N. Y.*

WATERVLIET Arsenal dates back to the War of 1812, when it was one of a group of depots established between Albany and Buffalo for collecting and distributing the military supplies required in the northern campaign of the United States Army. It immediately became the principal manufacturing establishment for ammunition and field artillery components.

In 1887 appropriations were made by Congress to convert the Arsenal into a large-caliber gun shop, all cannon up to that time having been procured from private concerns. Since 1918 the Arsenal has been equipped for making guns of all sizes above caliber 0.50, including the largest used by the armed forces of the United States Government. Articles describing the methods followed in making the huge 16-inch guns and their breech mechanisms appeared in MACHINERY for November and December, 1928.

The important part played by aircraft in modern warfare has given an impetus to the manufacture of anti-aircraft cannon. It was decided to equip one of the shops at Watervliet Arsenal for this work, and since 1935 about $1,000,000 has been expended for modernizing this shop. It is now being operated on a real production basis. Typical operations will be here described.

Centrifugally cast steel gun tubes are received from the Watertown Arsenal and gun forgings from private plants with preliminary turning op-

# Watervliet

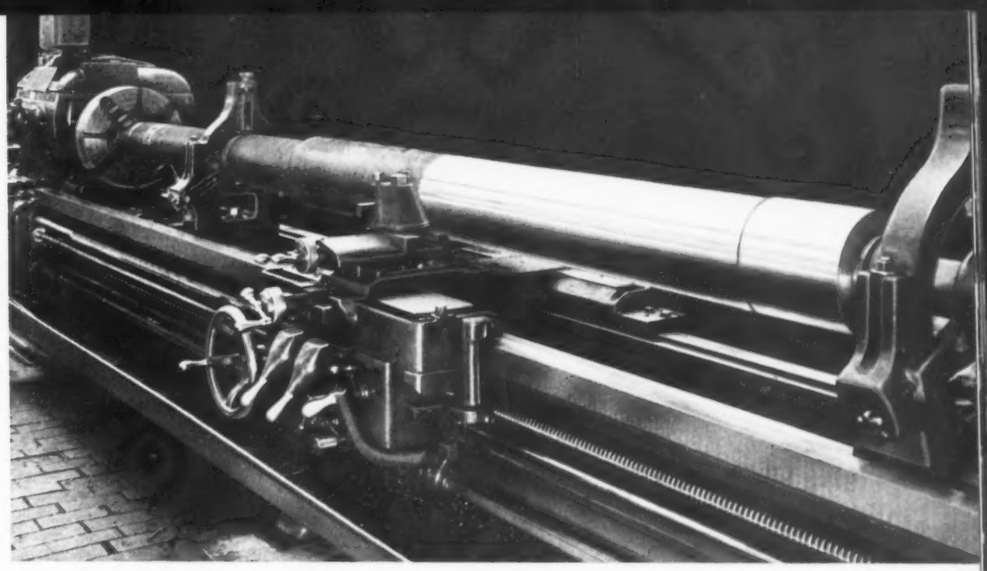


*Fig. 1. Gun Tubes are Rough-turned with Tungsten-carbide Tools at Speeds up to 260 Surface Feet per Minute with a Cut up to 3/8 Inch Deep and a Feed of 0.020 Inch*

erations having been performed. They are again rough-turned at the Watervliet Arsenal, Fig. 1 showing an operation of this type being performed in a Lodge & Shipley lathe on a 150-inch long tube for a 3-inch anti-aircraft gun. In the roughing operation on the tough material from which this gun tube is made, a carbide tool takes a cut up to 3/8 inch deep at a speed of 258 surface feet per minute, the feed being 0.020 inch. The maximum diameter of this gun tube is 9.400 inches.

Rough-turning is followed by step-boring and rough- and finish-taper boring, after which the gun tubes are finish-turned. Step-boring is accomplished by using 14 hog-nose reamers, which leave a series of cylindrical bores that decrease in diameter from the breech to the muzzle end. The tube is thus prepared for taper boring. The taper boring operation illustrated in Fig. 2 is being performed in a LeBlond lathe equipped with a bed approximately 60 feet in length. In both rough- and finish-boring, use is made of long packed-bit reamers constructed with a steel arbor to which two long cutting blades are attached, and hard maple blocks that are made to a diameter slightly larger than the gun bore. The maple blocks are squeezed into the bore and thus hold the tool firmly.

The gun bores are tapered 0.005 inch per inch of length and so several taper reamers must be used to bore a gun tube for its entire length. In the operation shown, a taper reamer 31 inches long is being entered into the breech end of a 3-inch anti-aircraft gun for boring the muzzle end. Twelve taper reamers are required for roughing and finishing this gun tube. Each reamer is provided with a brass cylindrical pilot at the front end which engages the rough bore.

Oil at a pressure of 100 pounds per square inch is forced through the long tool-bar and discharged through a number of orifices along the cutting blades. The gun tube bore tapers from 4.584 inches at the muzzle end to 6.119 inches at the breech end. Limits of plus 0.002 inch minus nothing must be maintained on the internal diameters, which are checked every inch of the gun length.

A thread of modified Acme form, 0.20 inch deep and of 0.750 inch pitch, is being chased on the end of a gun tube in Fig. 4 to receive a breech ring, the operation being performed in a Lodge & Shipley 36-inch lathe. In the illustration a form cutter is shown being used for rough-cutting the thread. In taking the finishing cuts, different tools are used for the bottom of the thread, the pressure side and, finally, the clearance side.

These gun tubes are later ground on a long Norton cylindrical grinding machine, as shown in Fig. 5, along the section that will be supported by the recoil cradle of the gun mount. The nominal diameter of this section on the gun tube shown is 9 inches. This diameter must be held within minus 0.005 inch plus nothing.

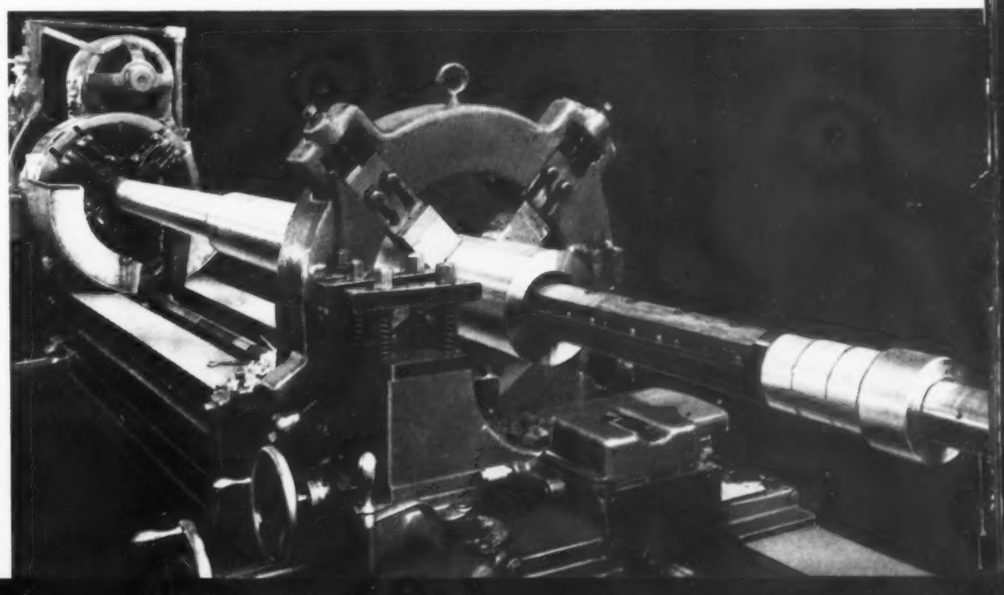


*Fig. 2. The Tapered Bore of Anti-aircraft Gun Tubes is Finished by the Use of a Succession of Packed-bit Two-bladed Reamers*

# Producing

*By COLONEL EDWIN D. BRICKER, Commanding Officer*

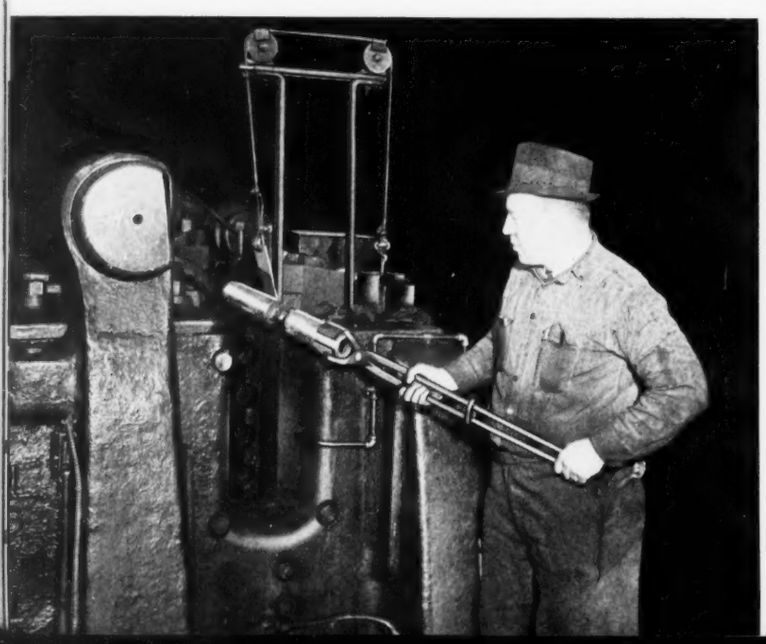
THREE distinct manufacturing divisions have been established by the Ordnance Department at Frankford Arsenal, Philadelphia, Pa., for the production, first, of ammunition for small arms, such as pistols, rifles, and machine guns; second, of shells and cases for artillery projectiles; and third, of fire-control instruments. The ammunition produced by the Arsenal has a world-wide reputation for accuracy, which is a direct result of the careful manufacturing and inspection methods employed. Fully as great precision is necessary in making the instruments used for determining the correct setting of anti-aircraft, artillery, and coast defense guns. It is, therefore, with justifiable pride that the personnel of Frankford Arsenal can point out many of the manufacturing practices. There are approximately 3000 civilian employes.

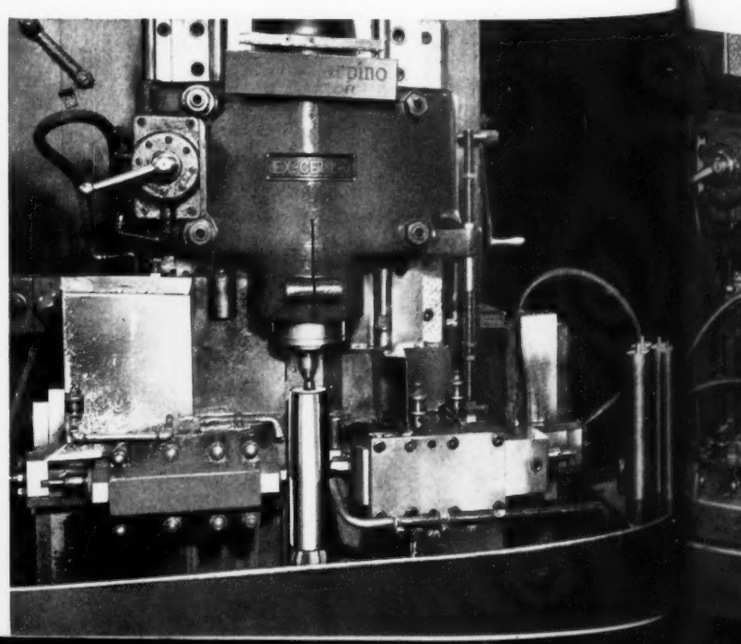
The Artillery Division has the most modern equipment, $2,250,000 having been expended in this division for new machinery during the last two years. These funds have enabled machining lines to be set up for the manufacture of shells and cases up to 5 inches in diameter on a real quantity-production basis. Power-driven and gravity conveyors facilitate the handling of the shells between the different machining operations. Whereas thirty-two to thirty-five separate operations were formerly necessary on a typical shell, only ten or twelve are required with the modern machine tools.

Shells for 3-inch and 75-millimeter guns and for trench mortars are upset from bar stock in the

*Fig. 1. Two Shells for 3-inch Guns are Forged from One Piece of Bar Stock After Heating in an Induction Furnace*

*Fig. 2. The First of Two Precision Turning Operations Performed on Artillery Shells with Tungsten-carbide Tools*





# *Projectiles at Frankford Arsenal*

National forging machine illustrated in Fig. 1, two shells being produced from one piece of bar stock. One-half of the bar is heated to 2100 degrees F. in an Ajax-Northrup induction furnace of the high frequency type. This end of the bar is then placed successively in the four impressions of the forging machine dies for upsetting the stock to the required outside dimensions and for piercing and shaping the inside. After one end of the bar has been forged, the opposite end is heated and forged in the same manner. The two shells are cut apart in the dies of a press.

Shell forgings of the sizes mentioned are turned in two operations on Ex-Cell-O machines of the type shown in Fig. 2, after they have been rough-machined in a lathe. The shell is supported between a large center at the bottom and a conventional center at the top. The turning cuts are taken simultaneously by tungsten-carbide tools mounted on two carriages, the one at the right of the work being fed from the top of the forging to the middle, and the one at the left from the bottom of the forging to the middle. During these feeding movements, the tool rams are fed in and out horizontally to suit the contour of the shell. These movements are produced by the engagement of a tongue near the outer end of each ram with cam bars attached to the machine frame. When the tools reach the positions shown, the carriages automatically stop feeding and return to their starting positions. They are operated hydraulically. The first of these precision turning operations is illustrated in Fig. 2.

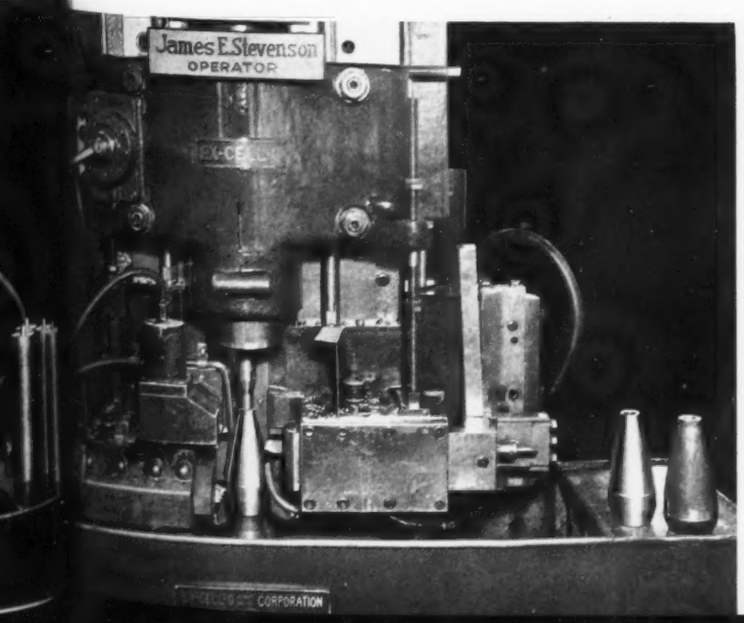
*Colonel*
*Edwin D. Bricker*
*United States Army*

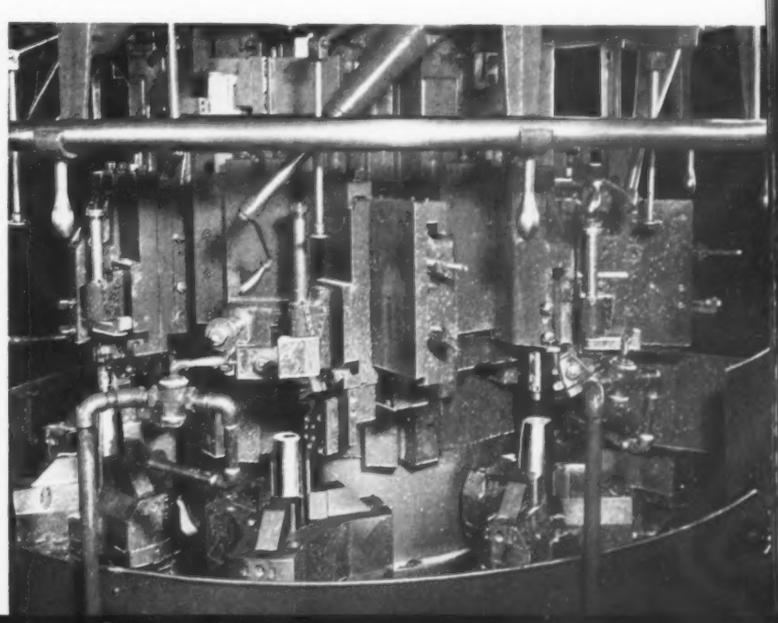
The finish-turning of shells for trench mortars requires cams of much greater rise, as will be apparent from Fig. 3, which clearly shows the contour of such shells. At the right of the machine is seen a shell as it appears after this operation and another shell as it appears after the preceding operation, which is performed in a Bullard Mult-Au-Matic. In that operation, the mortar shell is drilled, bored, reamed, recessed, and tapped on the inside, as well as turned on the outside a sufficient amount to obtain a surface that is concentric with the inside surfaces. When these shells leave the Ex-Cell-O machine their weight must be within 0.10 pound of the specified amount.

Three-inch and 75-millimeter shells go to a Bullard eight-station Mult-Au-Matic after the finish-turning operation. Two of the stations at the front of this machine are used for loading, each shell being passed twice around the machine, first

*Fig. 3. The Contour of Mortar Shells is Accurately Obtained on This Type of Machine through the Action of Cams*

*Fig. 4. Two Operations in a Series Performed by a Mult-Au-Matic Internally and on One End of Artillery Shells*



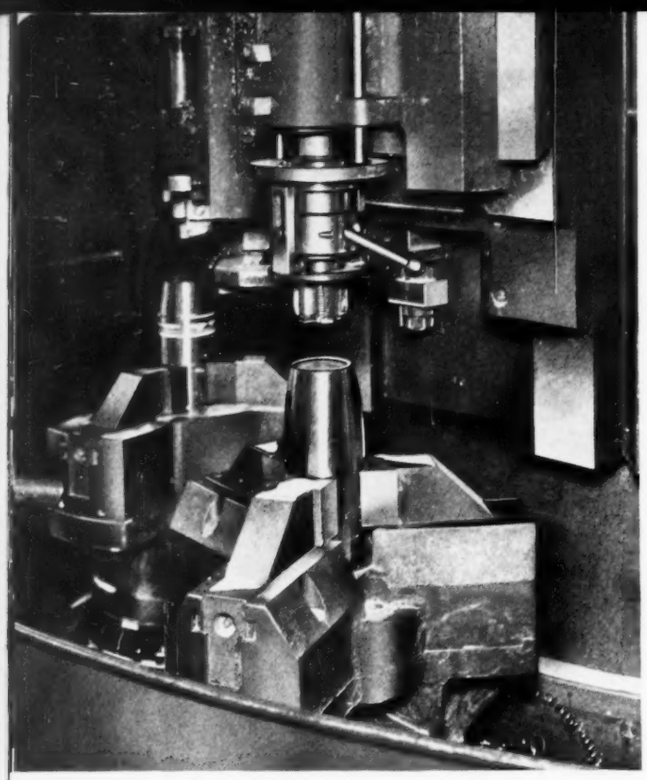


*Fig. 5. Tapping of the Bored Nose is the Fifth in the Series of Operations Performed by the Mult-Au-Matic*

with the nose up, and then with the base end up. The machine indexes through two stations at a time. Special devices facilitate loading of the shells in the chucks.

A close-up view of the first and second working stations on this machine is shown in Fig. 4. In the first, at the right, the mouth of the shell is rough-bored and a short turning cut is taken. In the second station, the center lug extending from the base end of the shell is cut off by one tool, and at the same time, a second tool rough-faces the entire width of the base.

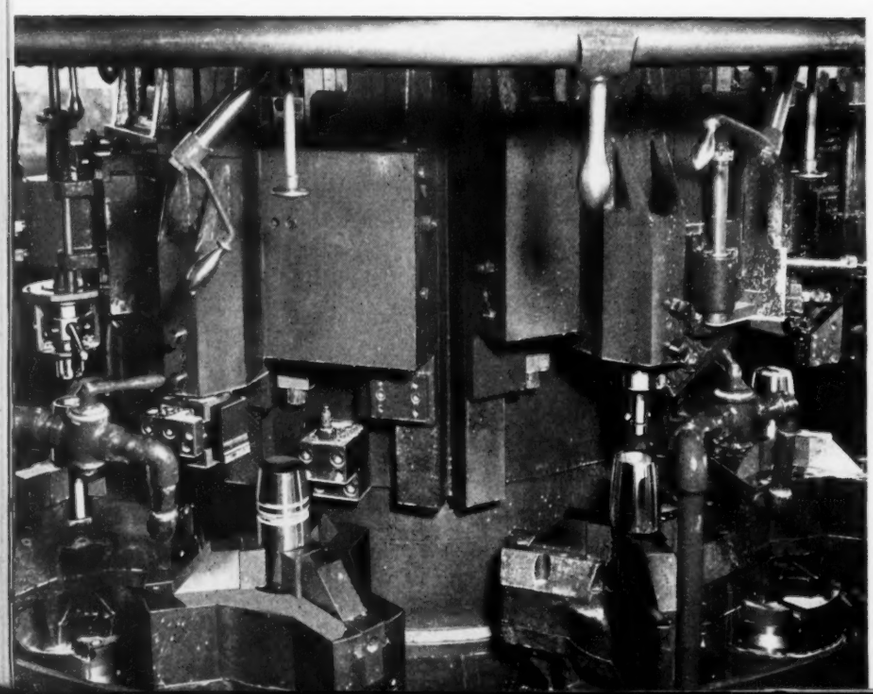
In the third working station, which is seen at the right in Fig. 6, the mouth end is finish-bored and an internal recess is cut by a second tool on the same spindle, which is fed radially after the boring tool has reached the bottom of its cut. The nose of the shell is also finish-faced in this station by a third tool on a block mounted at an angle on the lower end of the tool-head.

In the fourth working station, which is seen at the left foreground in Fig. 6, the band seat is turned on the outside of the shell by a form cutter, which simultaneously produces a series of grooves about 1/16 inch deep. This cutter is fed sidewise into the work after the tool-head has first been lowered to the proper height. In the fifth working station, which is shown in Fig. 5, a Geometric collapsible tap is employed to cut a 2-inch American screw thread, twelve per inch, in the shell nose. The sixth working station is used for finish-facing the shell base and for turning off the feather edge. Each working station of the machine is equipped with gages to insure correct setting of the tools. The boring tools, however, are set radially by means of hand gages.

The shells next pass through notching, nomenclature stamping, and knurling operations, after which they reach the machine shown in Fig. 7, which squeezes a copper rifling ring into the knurled seat near the base of the shells. As will be seen from the shell standing on the machine frame at the left, the copper ring is large enough

*Fig. 6. The Third and Fourth Operations on the Mult-Au-Matic Bore and Recess the Nose End and Turn the Band Seat*

*Fig. 7. Equipment Employed for Pressing a Copper Rifling Band into the Knurled Grooves near the Base End of the Shell*



in diameter to be slipped over the shell. Each shell is placed in the center of the segmental die of this machine, and the ring is squeezed tightly into the band grooves when air pressure at 900 pounds per square inch is admitted into the six die cylinders.

The copper band is next turned to a straight diameter and to a taper in the Sundstrand Stub lathe shown in Fig. 9. Tools on the front slide at the left in the illustration take straight roughing and finishing cuts as the carriage feeds toward the headstock, while a form tool in the rear slide is fed forward for machining the bevel.

The final operation on these particular shells is to weld a thin disk of steel to the base or closed end, as shown in Fig. 8. This disk serves as a seal for minute cracks in the shell that might admit gas to the inside of the projectile in firing a gun. The illustration shows this operation being performed on a Thomson-Gibb spot-welder, arranged with a mechanism that automatically indexes the shell between successive vertical strokes of the electrode. An air-tight weld is obtained by overlapping the welding spots.

*Fig. 8. Automatically Spot-welding a Thin Sheet of Steel to the Base End of Artillery Shells*

Among the new machines in the cartridge case shop is the 1000-ton H-P-M hydraulic press shown in Fig. 10, which is used to shape the head of the cases upon the completion of the drawing operations. The cases are slipped into dies, which have a central mandrel with the die impressions at the upper end; the dies are indexed clockwise from the loading position to the press ram at the back of the machine, which is fitted with a suitable punch. At the unloading station there is an air hoist equipped with a pair of tongs which grip the head of the finished cartridge case after it has been automatically lifted about an inch in the die. The man who tends the unloading station then operates a valve to raise the hoist tongs and the cartridge case, as shown, for convenient unloading.

Operations in the small-arms ammunition and instrument divisions will be described in a subsequent number of MACHINERY.

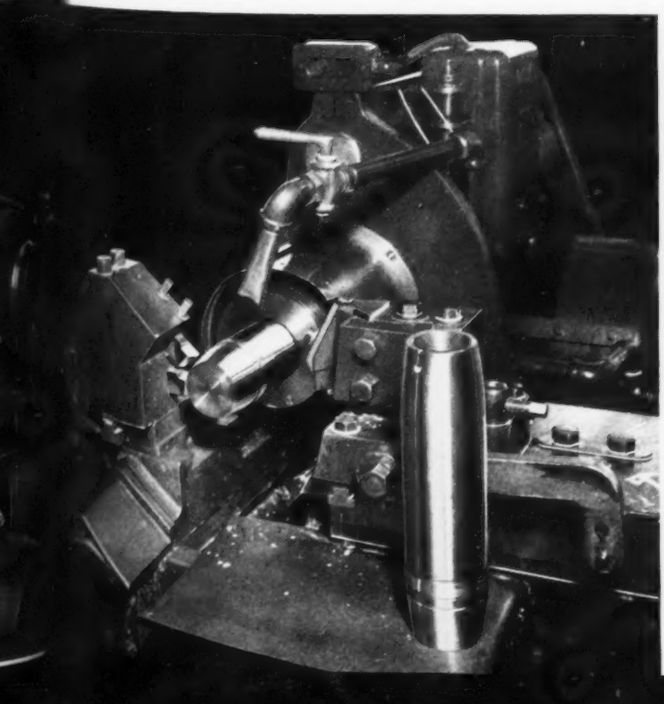


*Fig. 9. Turning the Copper Rifling Band on an Artillery Shell to a Straight Diameter and also to a Taper*

*Fig. 10. A 1000-ton Hydraulic Press Employed for Shaping the Closed End of Cartridge Cases*

# *Manufacturing Watertown*

*By*
*COL. ROLLAND W. CASE*
*Commanding Officer*

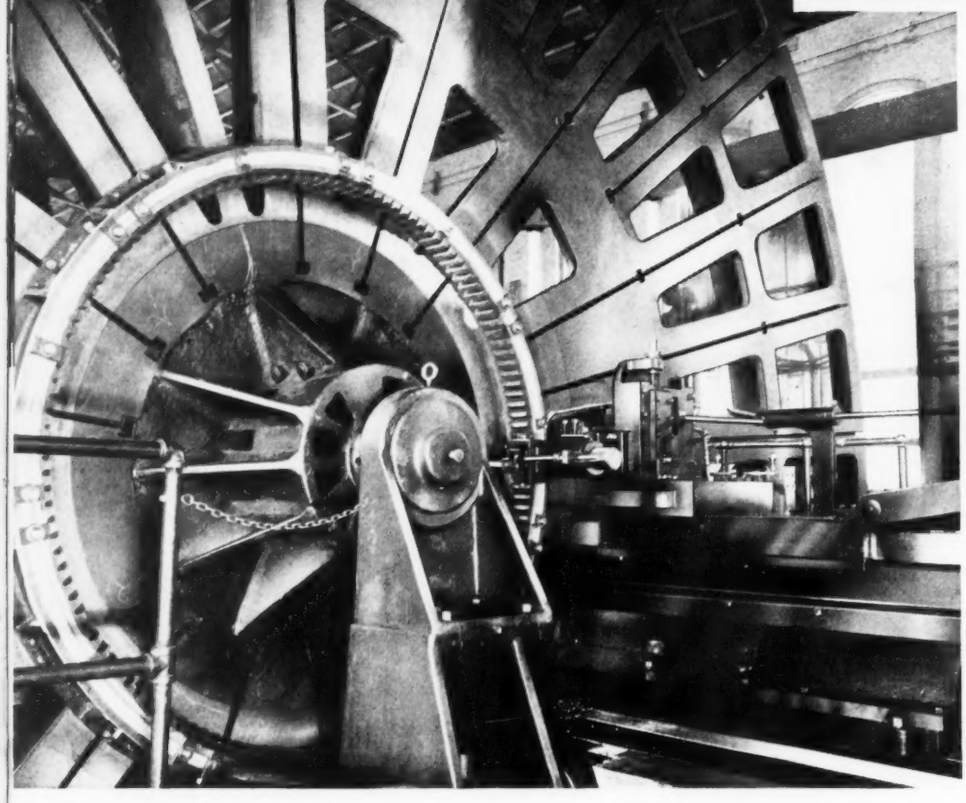


***Fig. 1. (Left) This Huge Gear Planing Machine Has a Faceplate 33 Feet in Diameter***

THE centrifugal casting of gun tubes and their cold-working by the application of hydraulic pressure on the internal surfaces constitutes one of the most outstanding manufacturing developments of the Ordnance Department during recent years. The operations involved in this highly interesting process were developed and are now being performed in the shops of the United States Arsenal at Watertown, Mass. All information concerning the operations is, however, strictly confidential and this article, therefore, will be confined to manufacturing processes that are somewhat less spectacular, but fully as important in keeping the United States Army equipped for maximum fighting efficiency.

One of the important functions of an arsenal is to serve as a laboratory during peacetime for the development of manufacturing methods that can be adopted immediately, in case of war, by private industrial plants called upon to produce similar munitions. The shops of the Watertown Arsenal are assigned primarily to the building of medium and heavy gun mounts, which are, of course, required in fairly limited numbers, and so the Arsenal is operated somewhat on a jobbing shop basis. Jigs and fixtures have, however, been provided for repetitive operations to save time and insure interchangeability.

During the last year or so a considerable number of machine tools have been installed to enable the manufacturing program to be accomplished by the most advantageous methods. Typical operations on these new machines and on some of the older ones will be described to show that government manufacturing plants can be operated as efficiently as the shops of private industry if comparable equipment is provided.

What is believed to be the largest gear-cutting machine in the world is illustrated in Fig. 1. This is a Gleason gear-tooth planer, installed primarily for cutting the gears used to train coast guns. The faceplate is 33 feet in diameter, and gears some-

# *Preparedness at Arsenal*

what larger than this can be accommodated. The internal gear being machined at the time that the photograph was taken was about 10 feet in diameter. Gear teeth can be cut with a circular pitch up to 3 1/2 inches.

The teeth are planed by the reciprocation of a tool-head that is actuated through an eccentric crank. The bed on which this tool-head is mounted can be fed across the front of the faceplate on wide floor ways which are normally kept covered by a wooden platform. Accurate indexing of the gears to insure proper spacing of the teeth is accomplished through an indexing gear about 15 feet in diameter back of the faceplate.

Another machine of outstanding interest is the 350-ton H-P-M hydraulic press shown in Fig. 2, which is used for straightening gun tubes. A tube for a 3-inch anti-aircraft gun is seen on the machine table. A gun tube of this size is straightened by the machine within 1/32 inch for its entire length. The machine table is stationary, the posts that support the overhead hydraulic pressure unit being mounted on carriages that run on tracks extending along the length of the bed. With this construction, the press ram can be positioned at any desired point along the tube.

The gun tube is supported on rollers at both ends. The rollers at the far end of the bed, as seen in Fig. 2, are provided with a motor drive for rotating the tube between successive applications of pressure. An open pit extends along the back of the machine to enable uninterrupted shifting of the pressure unit. A similar pit at the front is kept covered at all times by telescoping steel sheets.

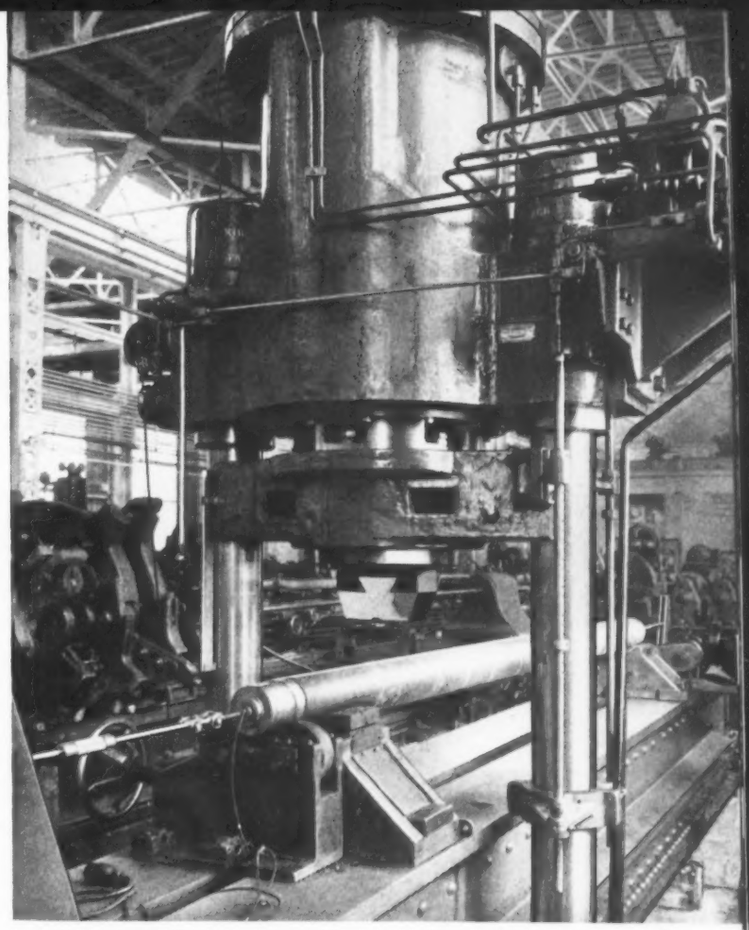
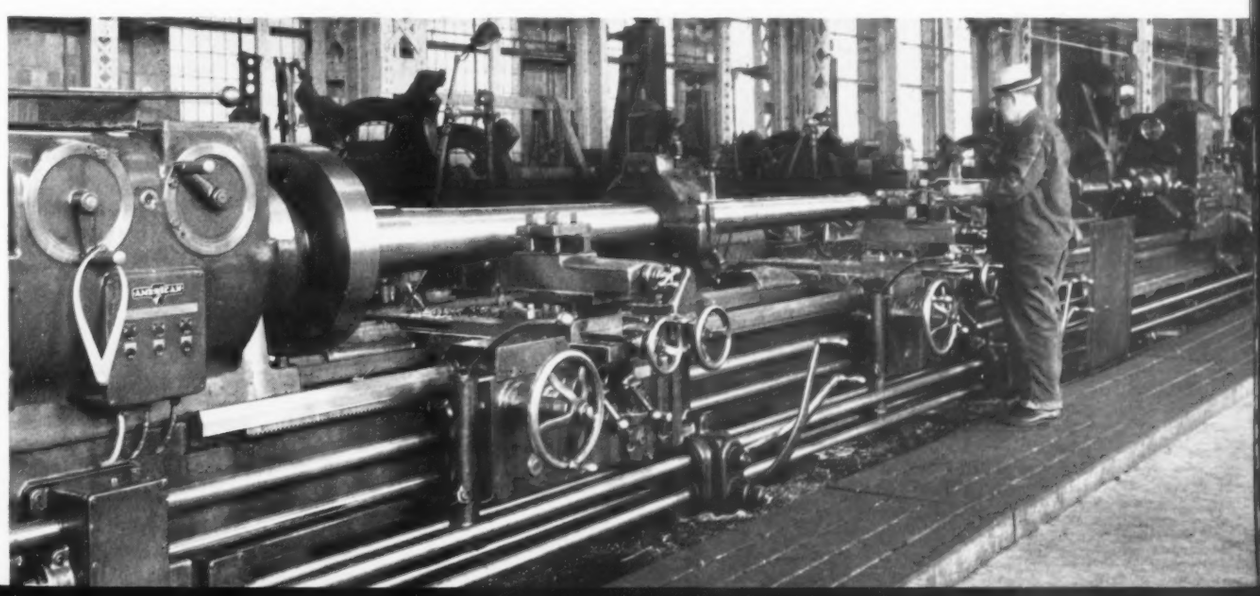


*Fig. 2. Hydraulic Press which Develops Pressures up to 350 Tons for Straightening Large Gun Forgings*

*Fig. 3. Gun Tubes up to 25 Feet Long can be Handled by This "Super" Gun Boring and Turning Lathe*



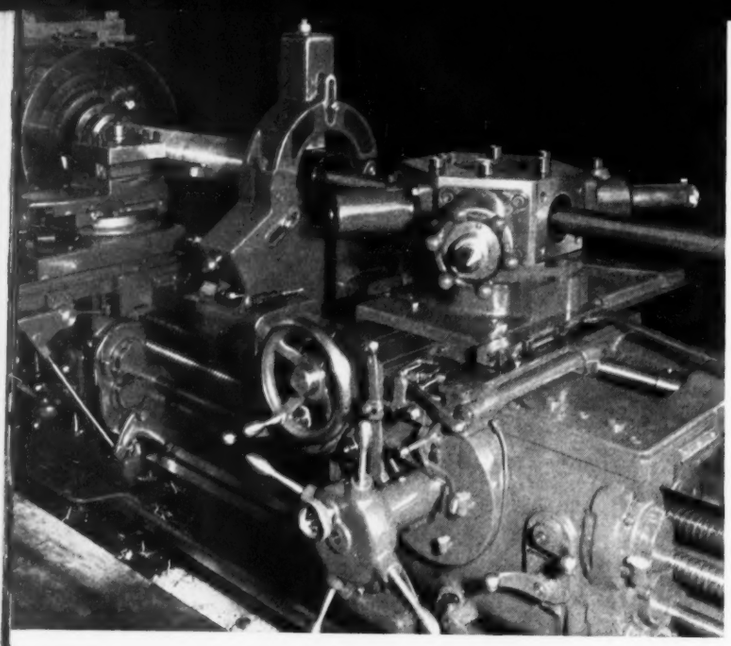


*Fig. 4. Turning and Boring a 4-foot Long Gun Tube in a Turret Lathe, Both Cuts being Taken at the Same Time*

A "super" gun boring and turning lathe, built by the American Tool Works Co., with a bed length of approximately 75 feet, is shown in Fig. 3. This machine has a capacity for handling gun tubes up to 25 feet in length. It is used for taking roughing cuts only, the tubes being finished at the Watervliet Arsenal. The gun tube is mounted in the left-hand end of the lathe and turned by tools on two carriages, a taper attachment being provided at the back of the bed for machining the tube to diminishing diameters as required.

Boring of the gun tube is performed by a hollow drill on a long bar, supported in steadyrests and driven and fed by a head at the right-hand end of the lathe bed. This head is advanced and returned by a lead-screw in the center of the bed. Holes up to 4 1/2 inches in diameter can be bored from solid forgings, although the tubes arrive at the machine with a forged hole. During the boring operation, coolant under a pressure of about 150 pounds per square inch is supplied to the tool through the hollow boring-bar to wash away chips and keep the tools and work cool. A watt-meter on the boring head gives a constant reading of the load on the boring tool.

Smaller gun tubes are bored on other long engine lathes and also on turret lathes, as shown in Fig. 4. In this illustration, a gun tube about 4 feet long, with a 4-inch bore, is being machined from cold-drawn tubing in a Gisholt turret lathe. Turning cuts are taken by tools on the compound rest while the bore is being machined by a tool attached to a long bar mounted on the hexagon turret. This machine is also equipped with a taper attachment, and oil is fed to the tool through the boring-bar.

The vertical turret lathe has proved efficient for the machining of small quantities of arsenal work.

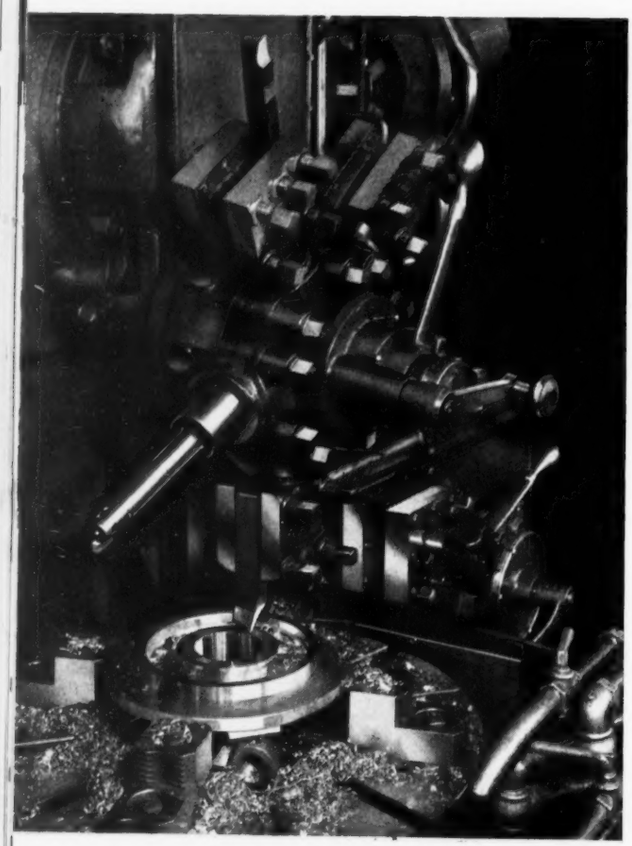


*Fig. 5. A Vertical Turret Lathe which has Proved Economical for the Rapid Machining of Small Quantities of Work*

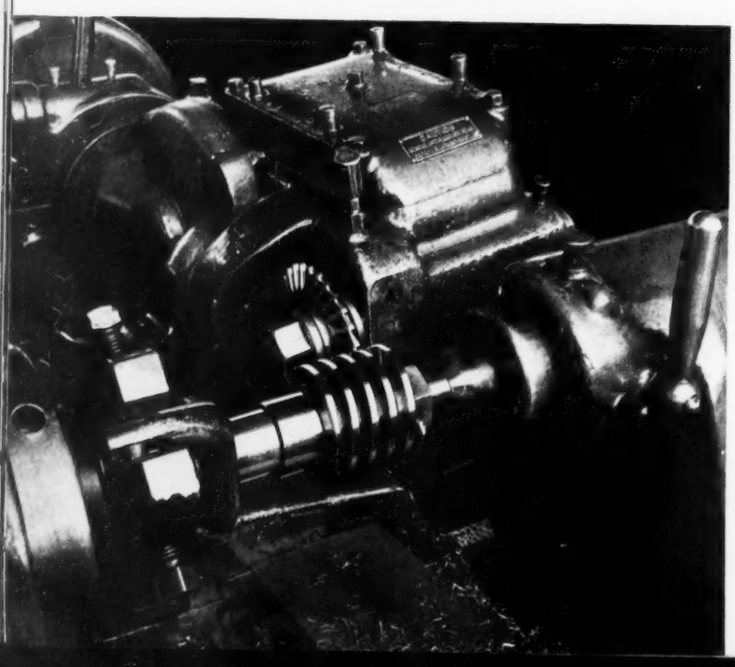


*Fig. 6. Cutting a Double-thread Worm of 3 1/2 Inches Diameter on a Standard Thread Milling Machine*

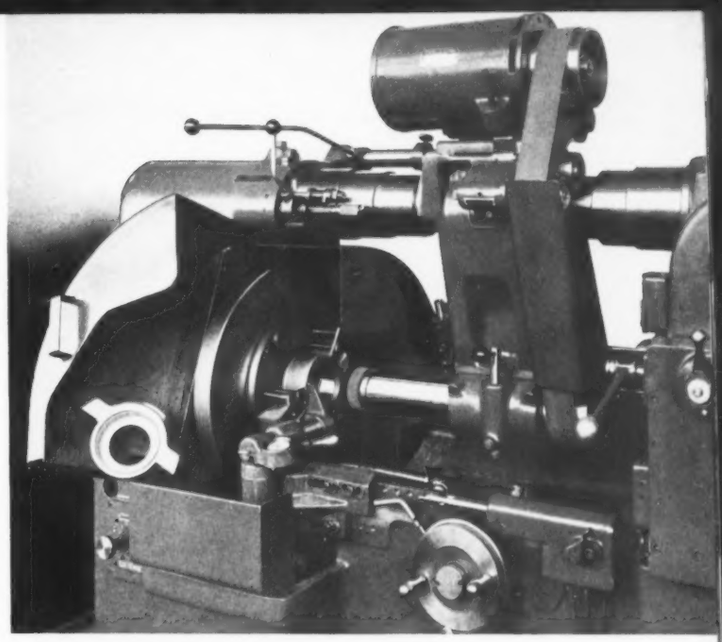


*Fig. 7. Anti-friction Bearing Housings are Ground Internally by This Machine to within 0.0001 Inch of the Specified Size*

Fig. 5 shows a Bullard machine of this type being employed for finishing a bronze friction clutch disk. Facing, turning, boring, and under-cutting are performed by applying the various tools on the turret. Both sides of the work are machined, the under side being flat across the entire part.

Worms are cut by quantity production methods in Pratt & Whitney thread milling machines, a typical operation being shown in Fig. 6. The worm shown is 3 1/2 inches in outside diameter, and has a double thread of 5/8 inch pitch.

A Pratt & Whitney vertical shaper is shown in Fig. 8 being employed for finishing locating slots at opposite ends of housings for anti-friction bearings. These slots are finished in two set-ups of the work, and the large rounded surface extending between the two slots is machined in a third set-up. In the latter operation, the work is held horizontally on the table and the cylindrical surface is fed past the cutter by indexing the circular table.

The same part is ground internally on the Bryant grinder illustrated in Fig. 7, approximately 1/32 inch of stock being removed around a surface about 5 inches in diameter. This surface must be ground to the specified size within plus or minus 0.0001 inch. An indicator gage shows the surface diameter without stopping the machine.

A typical operation on a Cincinnati vertical milling machine, shown in Fig. 9, consists of end-milling opposite sides of a forging arm. The indexing head facilitates accurate positioning of the opposite side of the arm after the first side has been milled. A dial gage is provided on the head of the machine for use in setting the tool accurately above the centers of the index head and tailstock.

This article will be concluded in a second installment to be published in MACHINERY.

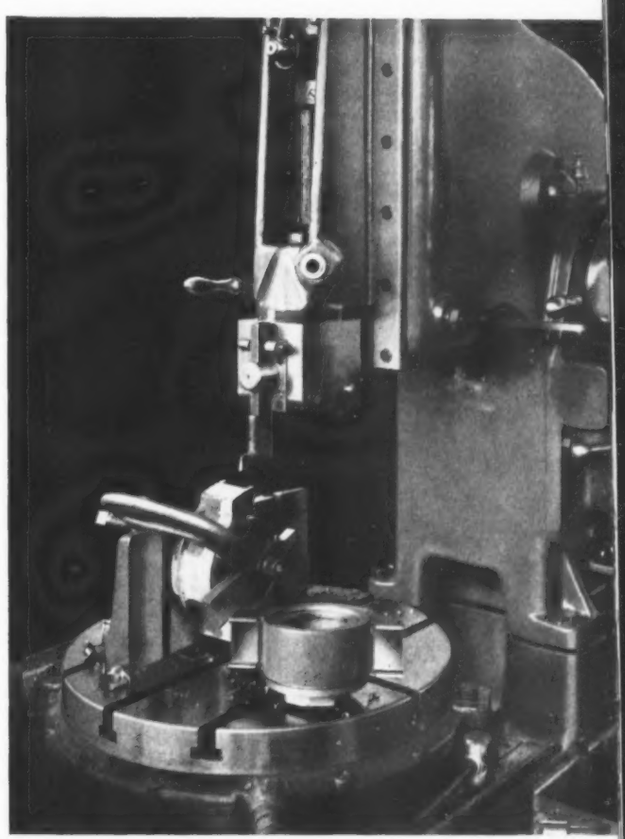


*Fig. 8. Employing a Vertical Shaper for Finishing Straight and Rounded Surfaces on an Anti-friction Bearing Housing*

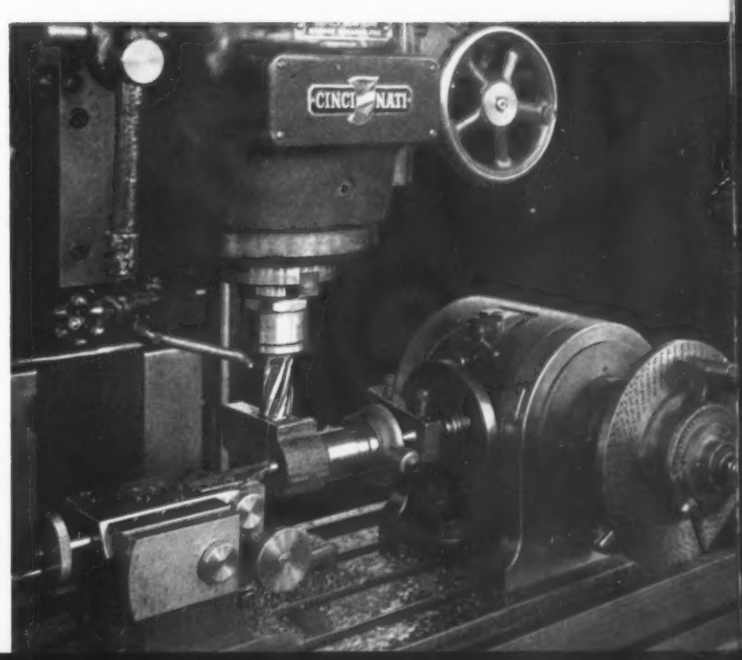
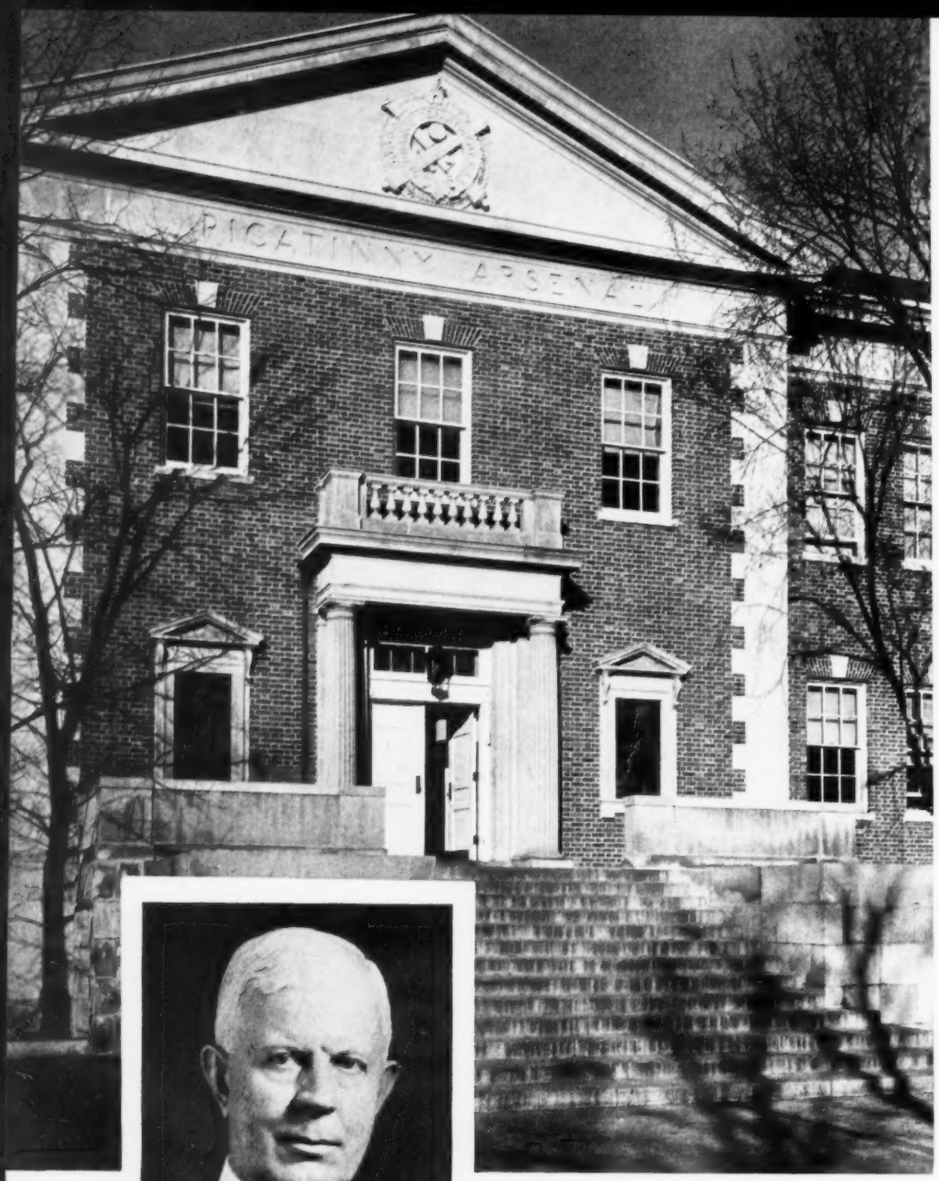



*Fig. 9. Using a Vertical Milling Machine for the Accurate Finishing of Opposite Sides on a Forging Arm*

# Picatinny

*By*
*COL. EDWARD M. SHINKLE*
*Commanding Officer*
*Picatinny Arsenal, Dover, N. J.*



***Colonel***
***Edward M. Shinkle***
***United States Army***

THE outstanding value of Picatinny Arsenal to the United States Army lies in its keeping alive during peacetime the art of manufacturing and assembling the ammunition required in time of war. This arsenal, located in the hills of New Jersey, serves as a laboratory in which men are constantly being trained to be experts in an art that finds little counterpart in private industry, but that would become of vital importance if Mobilization Day should arrive.

Detailed information has been recorded of manufacturing processes, and photographs and drawings made of special machinery, tools, and gages, so that private concerns could start the manufacture of these special products in case of emergency without the tremendous handicaps experienced at the beginning of the World War.

Since the readers of MACHINERY are engaged in the metal-working industries, this article will deal with operations in the manufacture of fuses for projectiles rather than with the production of powder, TNT, Tetryl, lead azide, and other explosives.

The visitor to the Metal Components Department of the Arsenal, in which fuses are manufactured, is impressed by the great variety of parts turned out by automatic screw machines. Some of the pieces are as small as 1/16 inch in diameter and some are less than 1/16 inch long. Tolerances as close as 0.001 inch must be maintained. On a typical cup-shaped piece of stainless steel with an outside diameter of 0.190 inch and a wall thickness of only 0.015 inch, the limits on the outside diameter are plus 0.000, minus 0.002 inch, and the limits on the inside diameter, plus 0.001 inch, minus 0.000. The over-all length of the piece must be 0.457 inch within plus 0.000, minus 0.002 inch.

In Fig. 1 is shown a Brown & Sharpe No. 2 high-speed automatic screw machine producing fuse booster cups from 1 1/8-inch aluminum bar stock. These parts have a wall only 0.03 inch thick at the open end when finished, and the closed end is 0.057 inch thick. The length is approximately 15/16 inch. In this operation, the stock is fed to a stop in the first station of the turret, after which the turret is indexed successively for rough-drilling, cutting the external thread with a Geometric die-head, flat-bottom drilling, reaming, and turning a short length in front of the thread. The turning is done with a knee tool seen in the illustration indexed in line with the work. A tool on the front slide forms the piece during the first drilling step, and a tool on the rear slide cuts the part from the bar at the end of the operation.

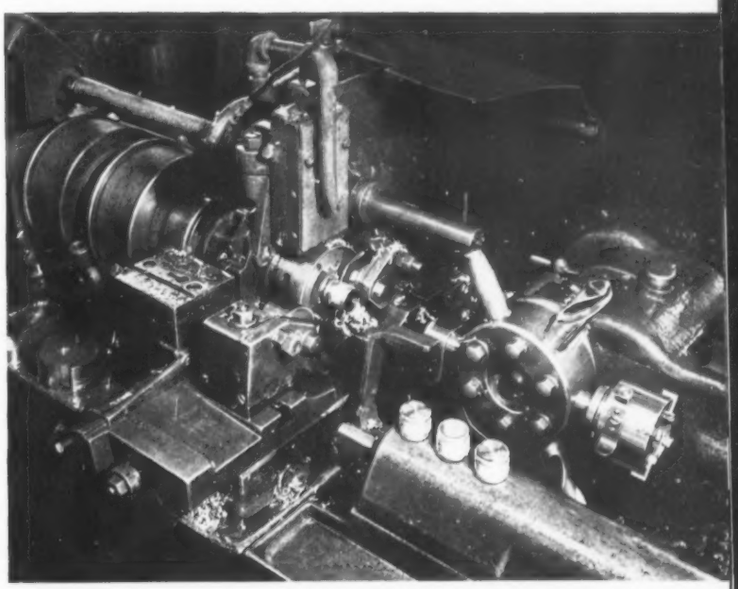
# Advances the Art of Making Ammunition

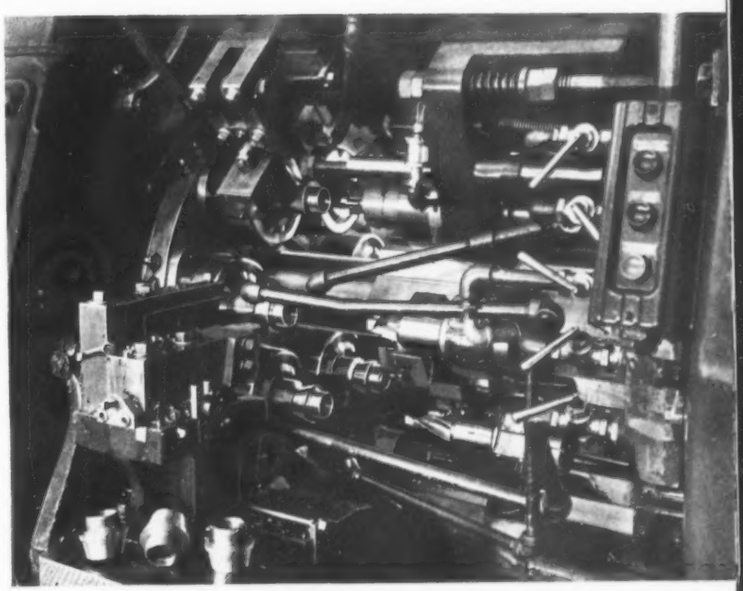
The threads are 1 1/8 inches in diameter, twenty per inch, NS-1. About 800 of these booster cups are produced per eight-hour day.

Fuse bodies of the type shown on the slides of the machine in Figs. 2 and 3 are produced at the rate of one piece every twenty seconds by the Acme-Gridley 2 5/8-inch automatic illustrated. The fuse bodies are produced from 2 7/16-inch cold-drawn free machining steel bars. In the first station of the machine, seen at the bottom in Fig. 3, the stock is fed forward to a stop, which is first fed upward into line with the station by an angular slide, and then withdrawn to permit the application of a drill on the main slide. At the same time, a tool on the bottom rear slide rough-forms the external surfaces of the part.

The part is then indexed to the front bottom position seen in Fig. 2 where a tool on the main slide drills to a larger diameter and roughs out the straight bottom of the hole. At the same time a tool on the front bottom slide semi-finish-forms the external surfaces. After the part has been indexed to the front middle position, a tool on the bottom slide finish-forms the external surfaces and partially cuts off the piece from the bar. At the same time, a tool on the main slide finish-reams the hole and faces the end.

In the front top position of the machine, a shaving cut is taken by a tool on the top slide to give a final finish to the external surfaces while a tap on the main tool-slide cuts the internal thread. Then in the rear top position, seen in Fig. 3, the external thread is cut by a Namco die-head equipped with circular chasers, which is mounted on the main slide. At the same time, a tool on the rear top slide takes a second cutting-off cut. Finally, in the rear middle position, an arbor on the main slide advances and holds the piece, while a tool on the top slide completes the cutting-off op-





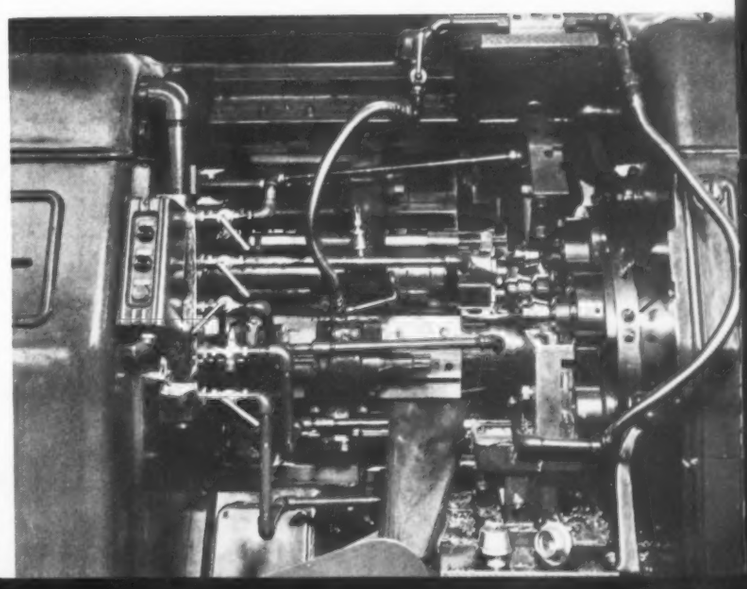
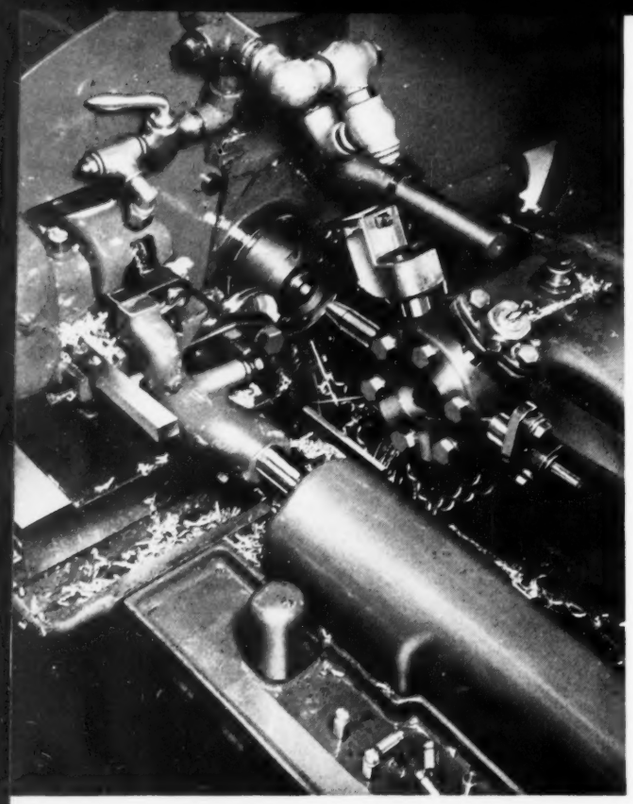
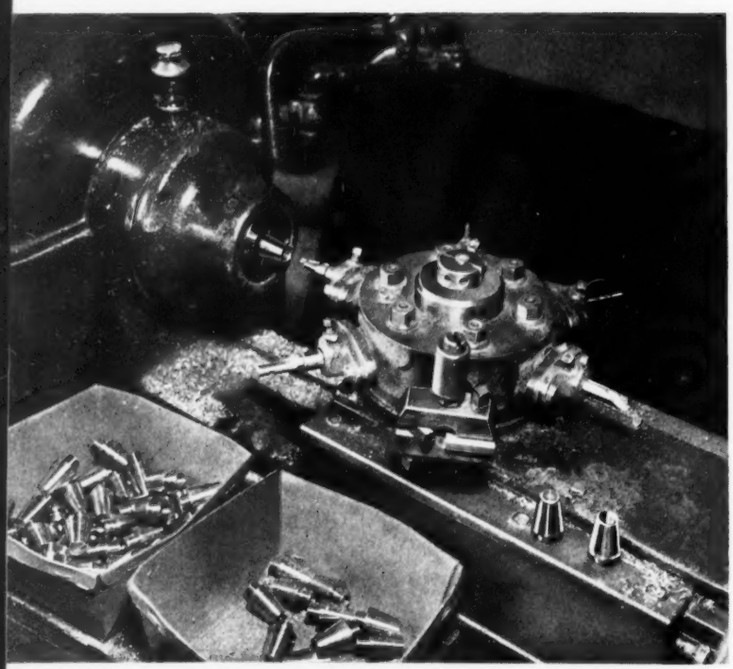


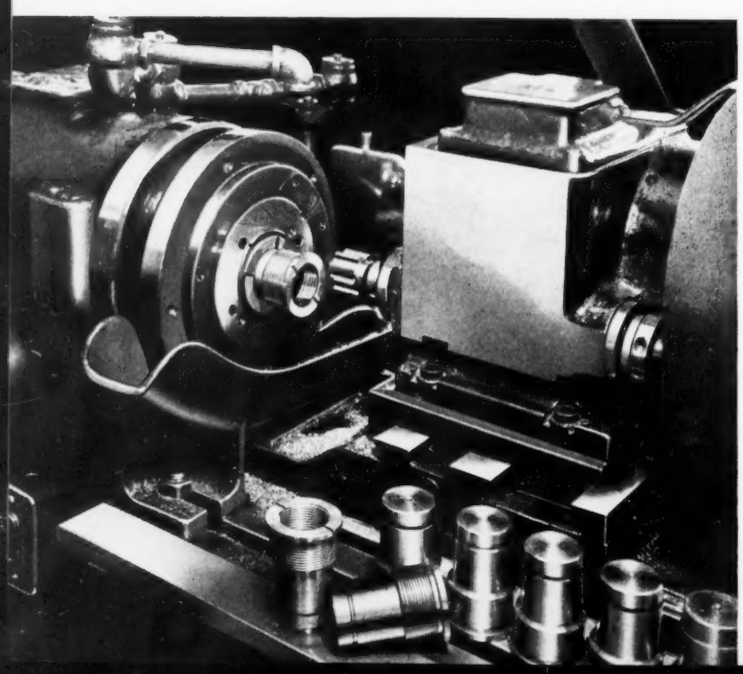
*Fig. 1. Producing Aluminum Fuse Booster Cups with a Wall Thickness of Only 0.03 Inch*

*Fig. 2. Acme-Gridley Automatic Equipped for Producing Fuse Bodies from Cold-drawn Steel*

*Fig. 3. Close-up View of the Tooling on the Rear Side of the Automatic Shown in Fig. 2*







eration. This piece has a maximum diameter when finished of approximately 2 3/8 inches, and is 2 3/16 inches long. A machine similar to the one used for the production of these parts is employed for machining bomb fuse bodies.

Fuse setting sleeves are made from 3/8-inch aluminum bar stock by the Brown & Sharpe No. OG high-speed automatic illustrated in Fig. 4. In this operation, the stock is fed to the turret stop, which is seen in line with the work. Then, with successive indexings of the turret, the piece is turned with the knee tool seen uppermost, drilled to a depth of about 7/16 inch, and reamed. During the drilling, the outside diameter is formed with a tool on the front slide, and after the reaming, the piece is cut from the bar stock by means of the cut-off tool on the rear slide. The piece is then automatically transferred to the front of the machine in line with a screw-slotting attachment for cutting a slot across the closed end. An average production of 3000 pieces is maintained per eight-hour day.

The second operation on brass fuse heads, which have previously been machined on a 1-inch Acme automatic, is shown being performed on a Bardons & Oliver electric turret lathe in Fig. 5, at the rate of 1200 per eight-hour day. The fuse head is loaded into the collet chuck, and then successively rough-drilled through a central rib by means of a No. 44 drill, rough-reamed, faced and burred, finish-reamed in the long hole, and finally finish-reamed in a short counterbore. This operation is also performed on a 1-inch Acme automatic with magazine feed.

Bomb fuse adapters of the type shown in Fig. 6 are threaded internally and externally on Hanson-Whitney thread milling machines. In the operation illustrated, an external thread is being milled behind an integral collar. The thread is 2 inches in diameter, twelve per inch, NS-1. The production per day on this machine is 325 pieces.

*Fig. 4. Automatic Tooled up for Forming, Drilling, Reaming, and Slotting Fuse Setting Sleeves*

*Fig. 5. Machining Fuse Heads on an Electric Turret Lathe at a High Production Rate*

*Fig. 6. Milling an External Thread on a Bomb Fuse Adapter Having an Integral Collar*

A Noble & Westbrook machine used in the fuse assembly division for marking the fuse bodies is seen in Fig. 8. The parts are placed vertically in different stations of a constantly revolving dial, which carries them past marking dies at the rear of the machine. Each piece is rolled by friction across the marking dies, with the result that the desired characters are clearly impressed in the fuse body. The pieces are automaticaly ejected from the dial as they reach the chute at the right. Six thousand pieces are marked per eight-hour day.

After an operator has inserted a small detonator into one end of the fuse head, the Chicago pneumatic compression riveter illustrated in Fig. 7 is used to stake the detonator retaining screw securely in place. The staking tool descends when the girl operates a foot-pedal to actuate an air valve, and forms four small depressions in the joining surfaces of the detonator retaining screw and the fuse body. The girl then screws the fuse head loosely into a fuse body, ready for the next assembling operation, which is shown in Fig. 9.

The loosely assembled unit is placed by the girl between a top spindle which has a taper socket that conforms with the contour of the fuse head and a lower spindle provided with keys that engage two small slots on the bottom side of the lower detonator socket. The upper and lower spindles revolve in opposite directions, so that the fuse head and the lower detonator socket, being made with threads of different hand, are automatically screwed on the body. When both pieces have been tightly assembled, an air valve is operated, and the upper spindle is raised to release the assembled fuse. The operator assembles 6000 units per eight-hour day, which is an average of more than 12 units per minute.

A final installment of this article will describe the drilling of high explosives and an electric-eye controlled powder-weighing scale.

*Fig. 7. Air-operated Device Used for Staking Lock Detonators Securely in Fuse Heads*

*Fig. 8. Marking the Fuse Bodies in a Machine Equipped with a Rotating Dial*

*Fig. 9. Machine that Assembles the Head and the Lower Detonator Socket to Fuse Bodies*

# *Modern Machines Promote Precision*

*By COLONEL NORMAN F. RAMSEY, Commanding Officer*
*Rock Island Arsenal, Rock Island, Illinois*

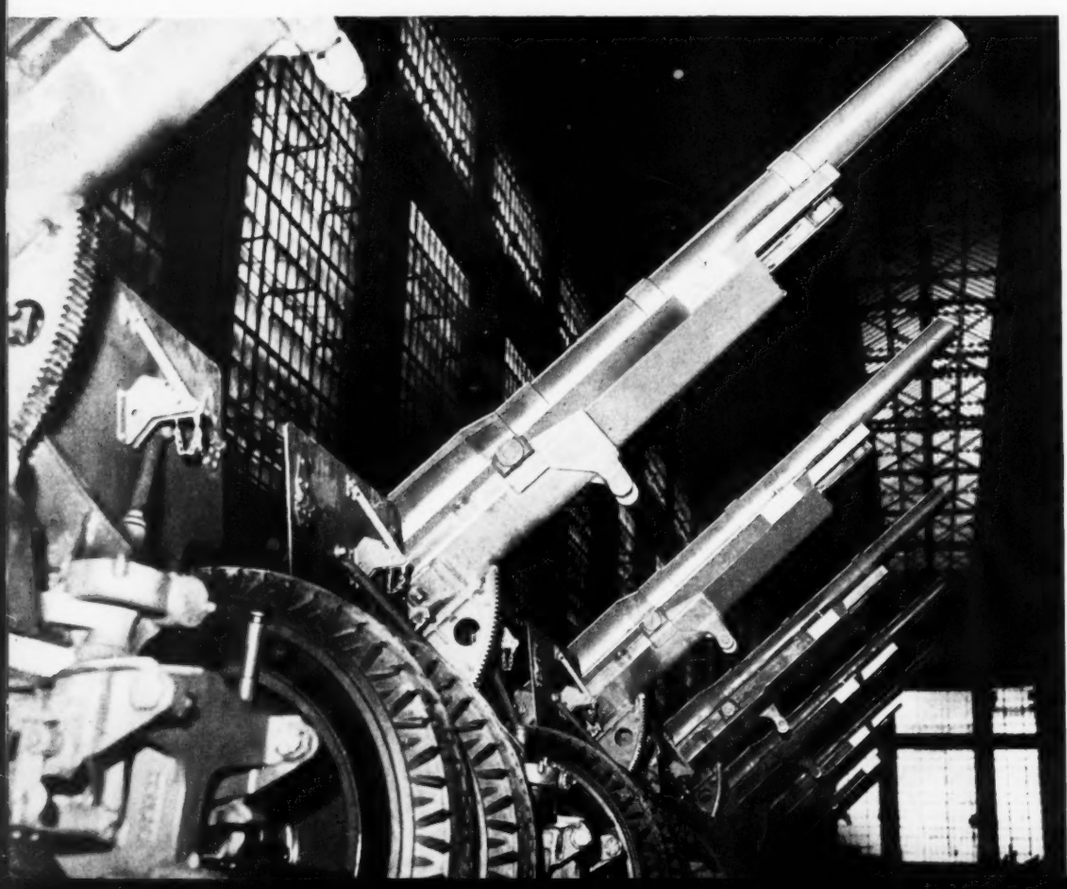
ROCK ISLAND Arsenal is unique in being the only manufacturing arsenal located at a distant point from the Atlantic Seaboard. Situated on a 900-acre island in the Mississippi River, the Arsenal is in a strategic position from a military standpoint. It was founded during the Civil War on a site occupied in 1812 by Fort Armstrong, which acquired prominence during the Black Hawk Indian War.

The Island was first used as a prison camp for Confederate soldiers, and the early buildings were erected by their labor. Afterward the Arsenal became a supply depot for all troops west of the Mississippi, manufacturing saddles, harness, and so on. With the coming of the Spanish-American War, metal-working machines of what were then considered production types were installed. The World War saw a large expansion in buildings, machinery, and number of civilian employes.

Today Rock Island Arsenal is equipped for the quantity production of tanks and machine guns for the infantry; combat cars for the cavalry; limbers and caissons for the field artillery; anti-aircraft gun carriages for the Army and Navy; and loading machines, powder hoists, and submarine torpedo-mine cases for the Navy. In the manufacture of such ordnance, there are numerous operations in which the close tolerances specified make it imperative to use modern machines of high accuracy. Considerable equipment of that classification has been installed within recent years, as will be shown in this article.

Honing has been developed to a high plane in the Arsenal shops, this process being applied to both internal and external surfaces. In Fig. 1, is shown a Barnes horizontal hydraulically operated machine used for finishing three cylinders in the recoil mechanism cradle for a 155-millimeter gun. The three bores have nominal diameters of 7.500, 5.375, and 3.3125 inches, and must all be honed within a tolerance of 0.0008 inch for the entire length of 92 1/4 inches. Two of the cylinders must be parallel to the cradle ways within 0.0001 inch.

Rough-, semi-finish-, and finish-honing are performed with Micromatic hones. In the roughing step, from 0.005 to 0.010 inch of stock is removed on the diameter; in semi-finish-honing, about 0.0015 inch is removed; and in finish-honing not more than 0.001 inch. The finish-honed surface must have a smoothness within 6 to 8 micro-inches.



*Colonel*
*Norman F. Ramsey*
*United States Army*

# *in Building Mechanized Ordnance*

Later the bores are machine-lapped longitudinally to a smoothness of 4 micro-inches. In the honing operations, a coolant consisting of oleic acid, kerosene, and turpentine gives especially good results, as it eliminates crumbling of the abrasive stones.

Two Barnes external honing machines of the type shown in Fig. 2 are used for finishing the piston-rods of recoil mechanisms to a smoothness within 8 micro-inches. Diameter and roundness are held within a tolerance of 0.0003 inch on rods, say, 60 inches long, the machine having a capacity for work up to 10 feet in length. About 0.005 inch of stock on the diameter is removed in the rough- and finish-honing operations. The piston-rods are of steel or Monel metal.

The honing head floats in a fixed position in the center of the bed, and the work both revolves and reciprocates through the hone. Being mounted in a floating holder, the hone is free to follow slightly curved rods. The hone is adjustable for diameter, but is of such a design that the abrasive stones are held solidly after being adjusted. Separate heads are used for rough- and finish-honing. There are six abrasive stones in each head.

From the external honing operation, the piston-rods are taken to the duplex hydraulically operated lapping machine shown in Fig. 3, which was also built by the Barnes Drill Co. In this operation, two heads with either stones or wood blocks 1 1/4 inches wide are reciprocated along the work. The piston-rods are indexed at each end of the stroke until they have been lapped completely around their circumference. With steel piston-rods, an abrasive stone is used for rough-lapping and a wooden block with a fine abrasive compound for finish-lapping. Piston-rods of Monel metal are lapped with a fine paper under the wood blocks. All together, from 0.0002 to 0.0008 inch of stock on the diameter is lapped off, just enough to remove the cross-hatch lines produced in honing.

In Fig. 4 is seen a rather unusual application of a Cincinnati centerless grinding machine. The operation consists of finishing sandblasted cold-drawn steel tubes, 5 1/2 inches in diameter, for a length of 7 inches on each end. Stock to a depth of 1/16 inch on the diameter is ground off within an accuracy of 0.001 inch. The operation is performed in one plunge cut of the grinding wheel.

The Jones & Lamson automatic thread grinding machine illustrated in Fig. 6 is used for grinding

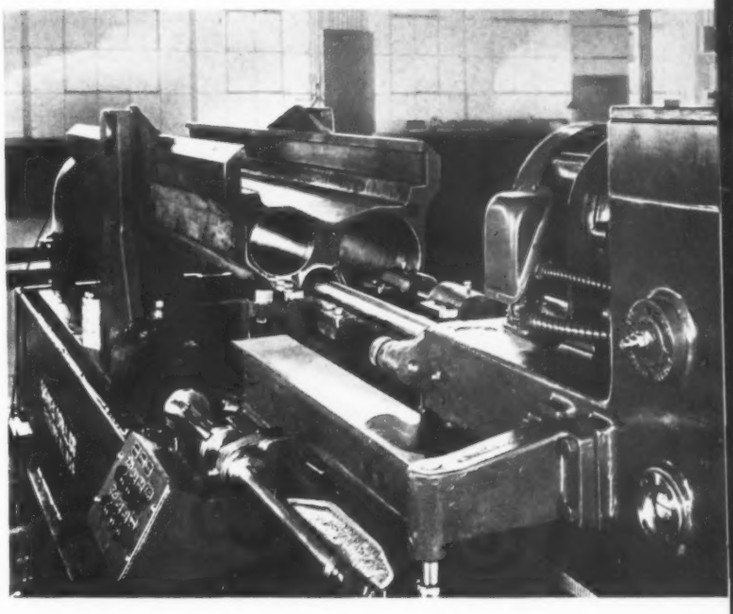
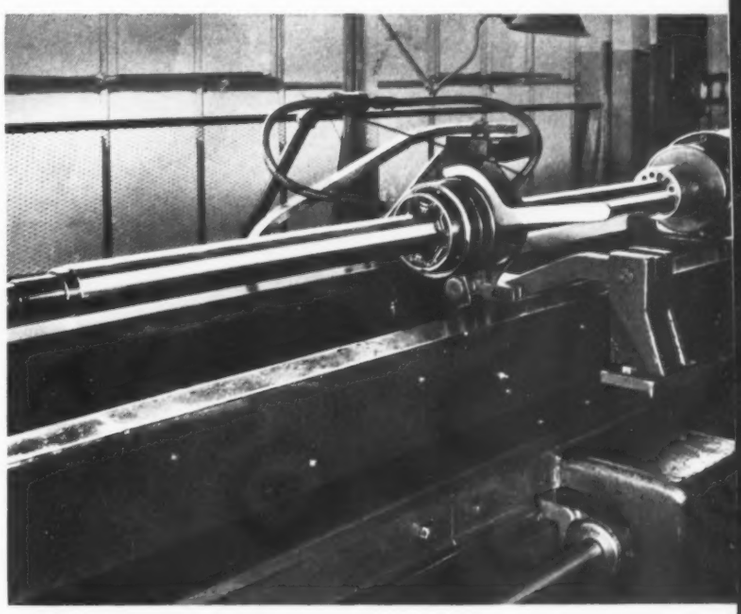


*Fig. 1. Machine Used for Honing Three Cylinders in the Recoil Mechanism Cradle for a 155-millimeter Gun*

*Fig. 2. External Honing Operation on a Steel Piston-rod, 5 Feet Long, in which the Work Revolves and Reciprocates*



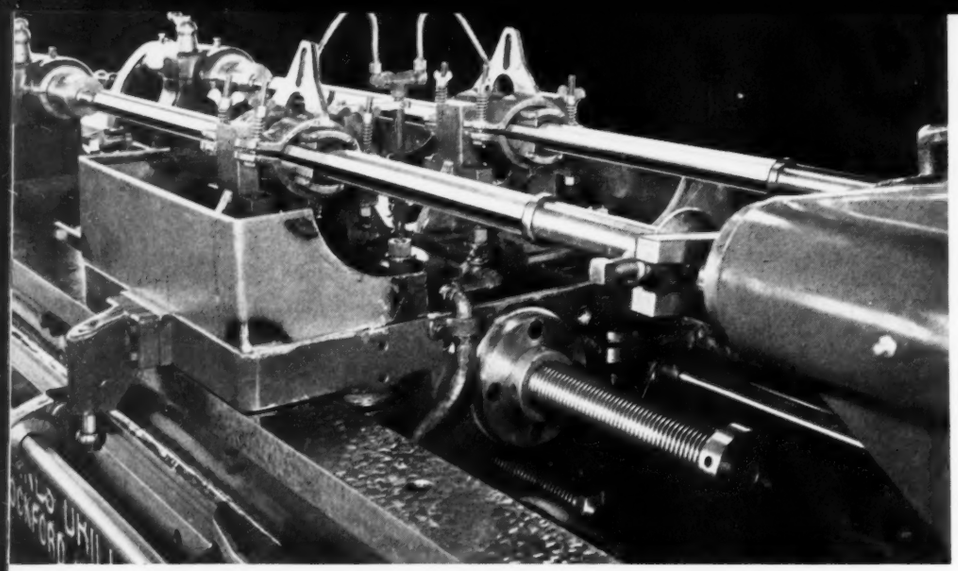


*Fig. 3. Lapping Two Piston-rods Simultaneously in a Machine that Reciprocates the Laps and Indexes the Rod*

threads from the solid on a large variety of parts, including threads as coarse as those seen on the Acme-thread tap lying on the top of the tailstock and on the worm lying on the headstock. The tap is 1 3/8 inches in diameter and has three threads per inch. It was ground to diameter, pitch, form, etc., within a tolerance of 0.0001 inch, about six passes of the tap across the grinding wheel being required to complete the job. In front of the worm is seen a traversing screw for an anti-aircraft machine gun sight which has a threaded length of 11 1/2 inches. These threads are 1/2 inch in diameter, and are held to form, pitch diameter, etc., within 0.0005 inch. They are produced with three passes across the wheel.

Kellermatic automatic tool-room machines are used in regular production, Fig. 7 showing a set-up in which four tank track sprockets are being milled simultaneously to the required form from steel disks. The desired contour of the sprocket teeth is produced by a tracer which automatically follows the sheet-steel templet seen above the work, a side-cutting end-mill as wide as the four sprockets being mounted on the tool-head. These sprockets are approximately 28 inches in outside diameter.

Kellermatics are also used for finishing the contours of cam forgings such as seen in Fig. 8 lying at the front end of the table. Two roughing and two finishing cuts are taken on each forging, the size of the tracer being changed for the successive cuts. Dimensions are held within 0.002 or 0.003 inch. The piece produced in the particular set-up shown has two distinct cam surfaces finished in one set-up. Cuts are taken both in the conventional manner and on the climb cut principle.

The cutting of internal teeth in the flywheel for a tank engine is performed on the Sykes gear generator shown in Fig. 5. With every indexing of



*Fig. 4. Grinding 5 1/2-inch Cold-drawn Tubes on a Centerless Grinding Machine*

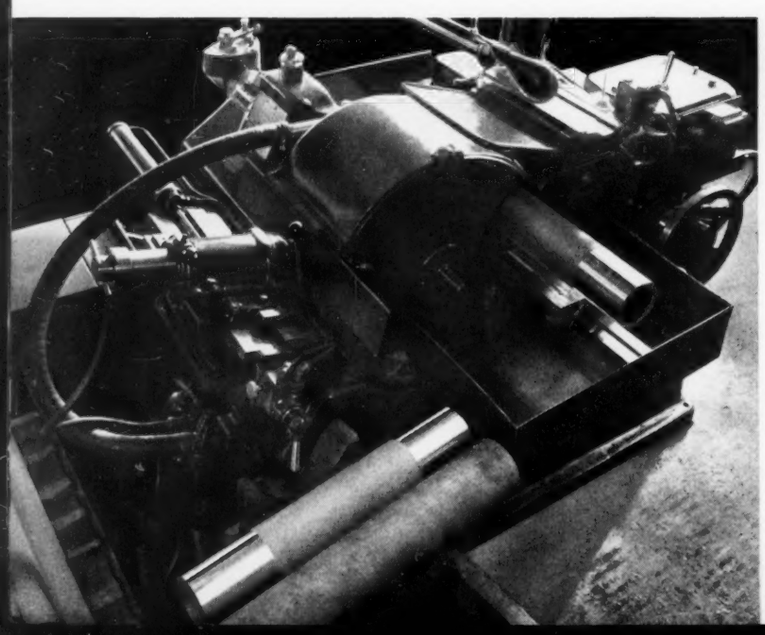
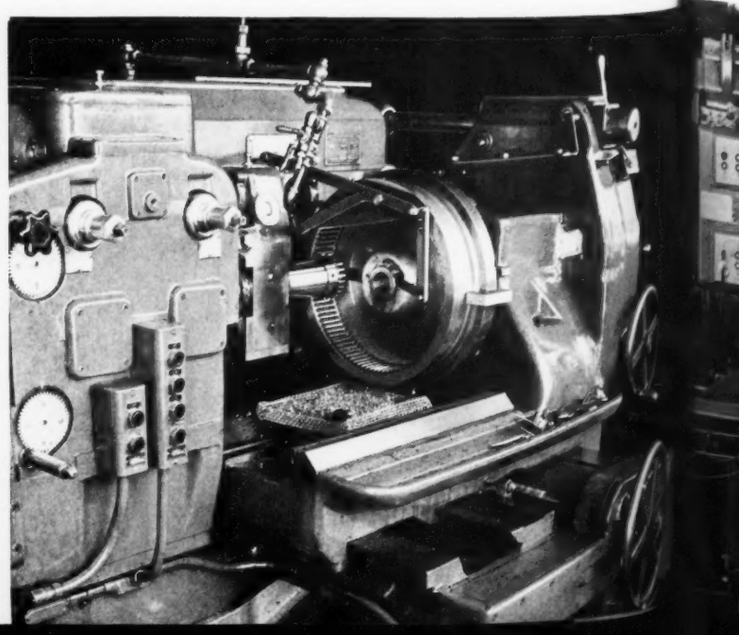


*Fig. 5. Generating Internal Teeth in the Flywheel for a Tank Engine*



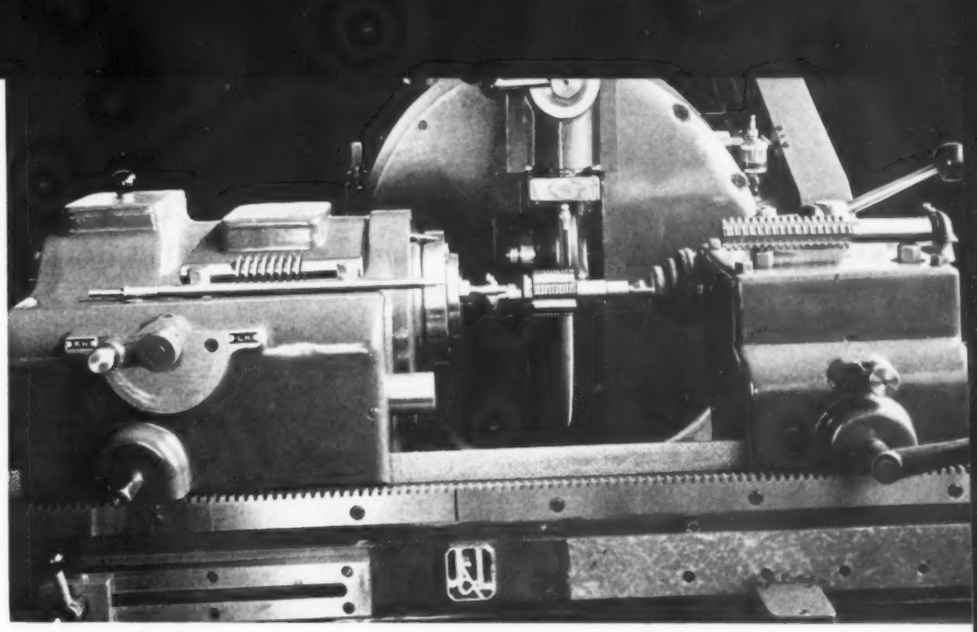


*Fig. 6. Automatic Thread Grinding Machine Used for Grinding Threads from the Solid on a Large Variety of Parts*

the work between the strokes of the gear-cutter, a narrow finger swings across the recess at the back of the work teeth to clear the recess of chips. The limits on the pitch diameter of 16 inches are plus 0.003 inch minus 0.002 inch.

Splines are hobbed on the final drive-shafts for tanks in the Barber-Colman machine illustrated in Fig. 9. These forgings are of chromium nickel steel, and are hardened prior to the hobbing operation to between 286 and 321 Brinell. The end being hobbed is 3 1/2 inches in diameter.

In the operation illustrated in Fig. 11, teeth of 12 diametral pitch are being cut around a bronze gear segment within a tooth spacing tolerance of 0.001 inch. The operation is performed on a Fellows gear shaper equipped with a special fixture, pivoted at the center of the segment, which is about 30 inches from the teeth. This fixture is geared to the regular table mechanism for obtaining the necessary generating movements. Three cuts are taken on the gear teeth.

A double-spindle Milwaukee machine especially designed for turning the trunnions on both sides of gun mechanism cradles within an extremely close alignment tolerance is shown in Fig. 10. The illustration shows the trunnions for a 3-inch anti-aircraft gun mount being machined. Although the trunnions measure 24 inches from end to end, they must be parallel and straight within 0.0005 inch. They are 2 1/4 inches in diameter when finished. The cutter-spindles are lined up by means of telescopic sights on the front of the cutter-heads.

This machine can also be used as a jig borer with horizontal spindles, provision being made for the use of measuring rods in positioning the table and heads. Precision boring heads are provided.

Flywheels, clutch plates, fans, and spring housings for tanks are balanced both statically and



*Fig. 7. Milling the Teeth on Four Tank Sprockets at a Time on a Kellermatic*

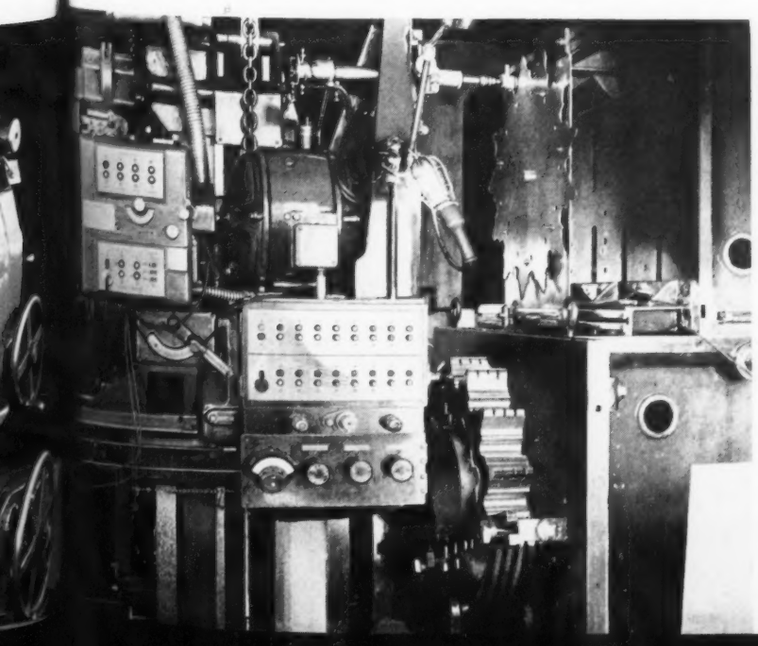
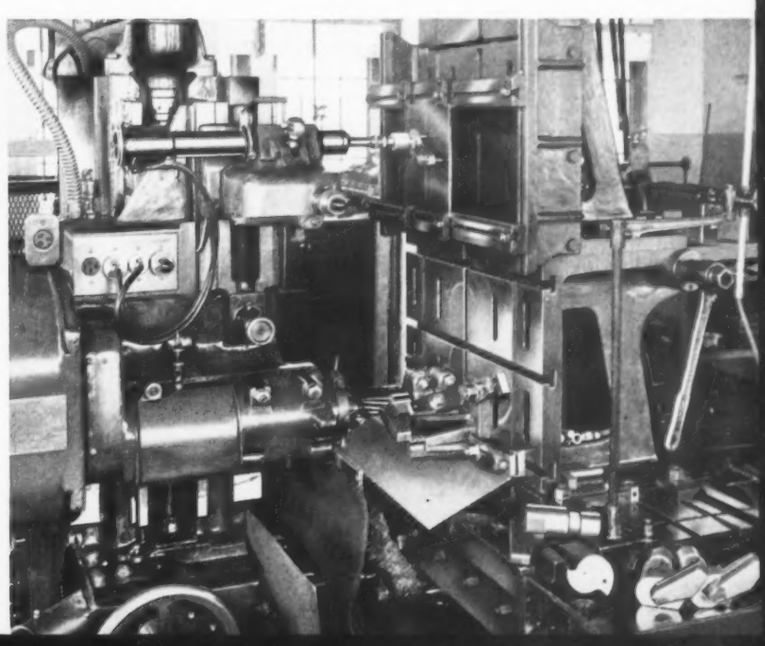


*Fig. 8. Kellermatic Used for the Accurate Machining of Cams as Seen on the Table*



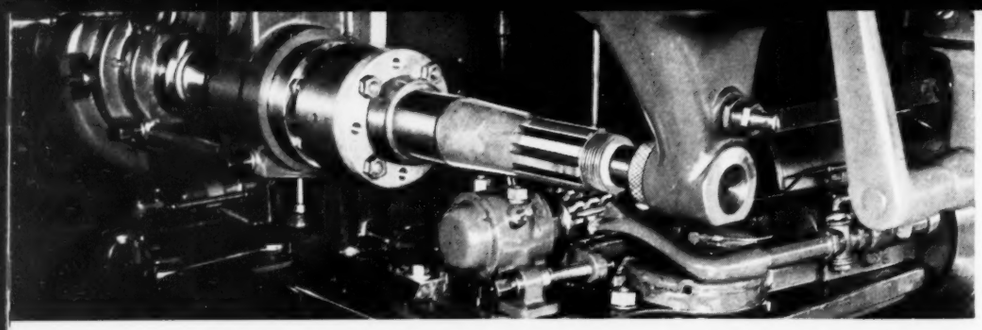


*Fig. 9. Hobbing Splines around a Tank Final Driveshaft, which is Forged from Chromium Nickel Steel and Hardened Prior to Hobbing*

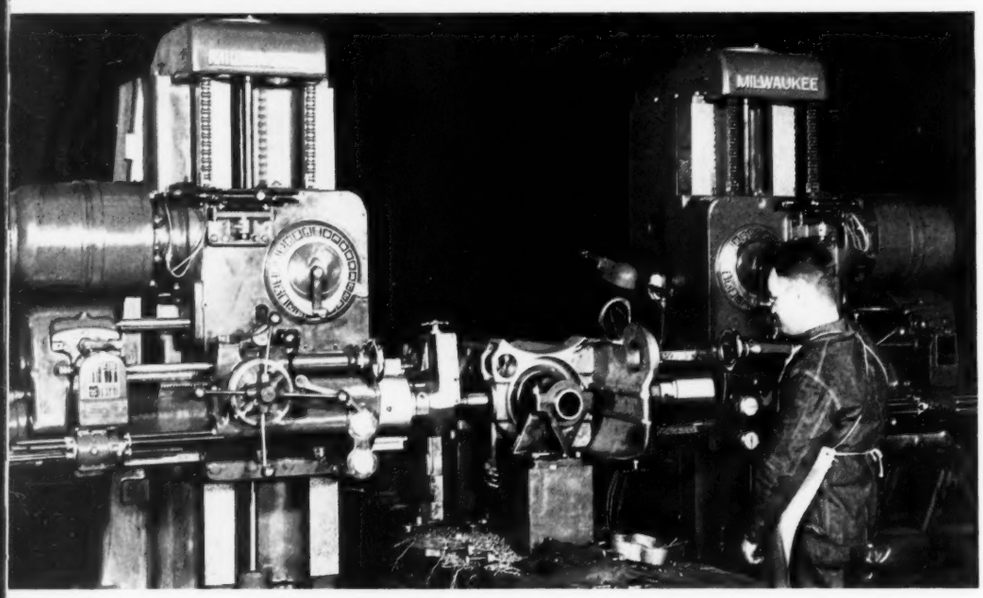



*Fig. 10. Special Two-head Machine that Simultaneously Turns Trunnions on the Opposite Sides of Gun Cradles to an Extremely Close Alignment Tolerance*

dynamically on the Tinius Olsen electric-spark testing machine shown in Fig. 12. These parts must be in balance within 0.1 ounce-inch. Corrections are made by filing off stock. In balancing fans as shown, the fan is mounted on the end of a long arbor, so as to magnify any unbalance. The fan is an aluminum casting 36 inches maximum diameter.

Two Henry & Wright dieing machines like the one illustrated in Fig. 14 are used in the Rock Island Arsenal to produce machine gun belt links or clips, one machine producing clips for caliber 0.50 cartridges at the rate of 72 per minute, and the other clips for caliber 0.30 cartridges at the rate of 104 per minute. The strip of stock shown in Fig. 13 indicates the sequence of operations performed by the seven-station die. The first die blanks out two small round holes which are used for locating the strip accurately in succeeding dies; the second die cuts a rectangular slot and begins blanking the piece; the third die performs another blanking operation; the fourth die curls the two ends of one piece and one end of the following piece; the fifth die continues curling the clip; and the sixth die completes it; the seventh die cuts the clip from the blank. An interesting feature of this progressive die is that arbors are slid horizontally

*Fig. 11. Cutting the Teeth around a Segment for a Gun Sight on a Fellows Gear Shaper*

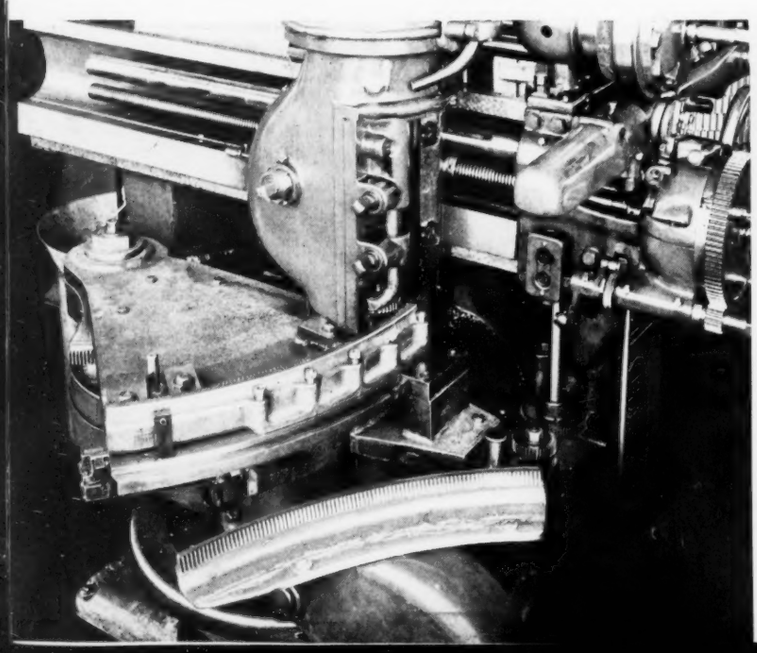
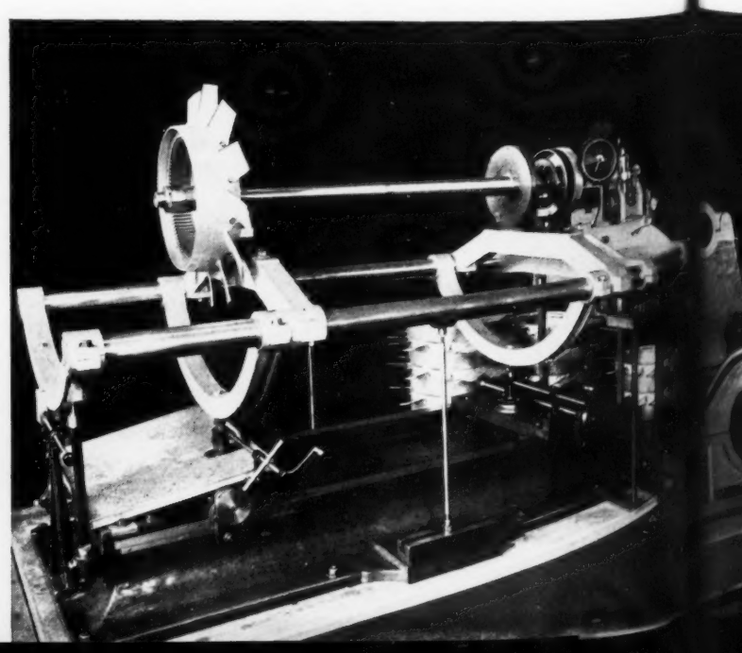


*Fig. 12. Flywheels, Clutch Plates, Fans, and Spring Housings are Checked for Balance*



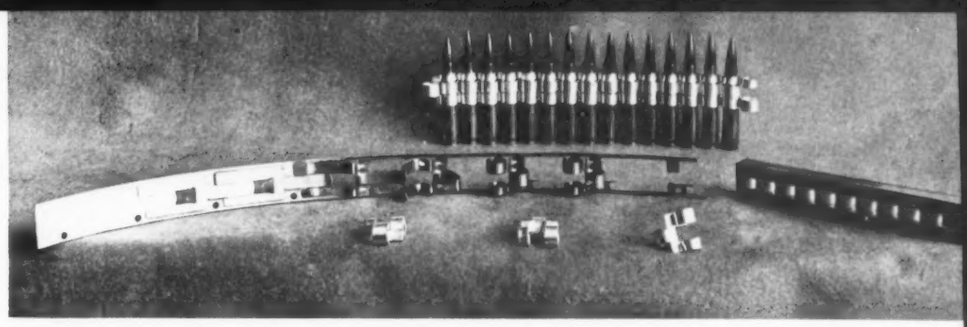


*Fig. 13. Strip of Stock which Indicates the Sequence of Operations Performed in the Production of Cartridge Clips*

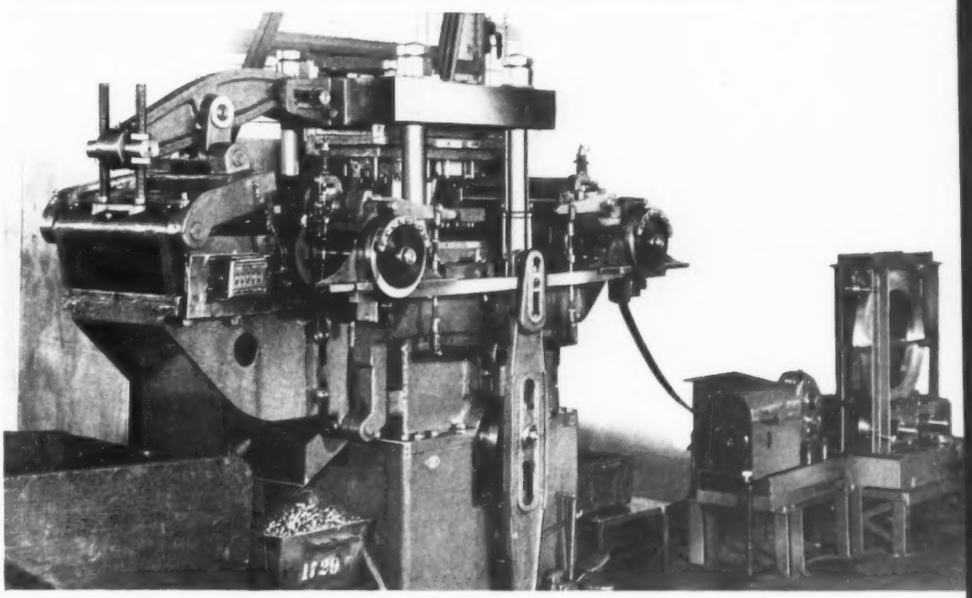


*Fig. 14. One of Two Henry & Wright Dieing Machines that Blank and Shape Clips at High Speed for the Caliber 0.30 and the Caliber 0.50 Cartridges*

into and out of the die cavities to enable the stock to be curled to the required diameter and form.

A typical operation on a universal horizontal boring, drilling, and milling machine is shown in Fig. 15. It consists of face-milling various vertical surfaces on an arc-welded steel pedestal for an anti-aircraft gun, all faces being held within limits of 0.002 inch as regards their distance from the center of the pedestal. Rough and finish cuts are taken. Boring cuts are also taken on this pedestal with the work set up horizontally. At the left-hand end of the machine table is a second fixture used in boring recoil cradles for guns.

Another boring operation on a recoil cradle is performed on the Giddings & Lewis horizontal boring, drilling, and milling machine illustrated in Fig. 16. A hole 9 5/8 inches nominal diameter is being bored in the operation shown to a length of 3 inches in both ends of the cradle; the hole must be true with respect to alignment within 0.001 inch, even though the over-all length of the cradle is almost 8 feet. The boring-bar is guided in an outboard bearing. Other holes are also bored in one end of the recoil cradle, but to wider tolerances.

A second installment of this article will be published in a coming number of MACHINERY.

*Fig. 15. Face-milling a Fabricated Gun Mount on a Horizontal Boring Mill*

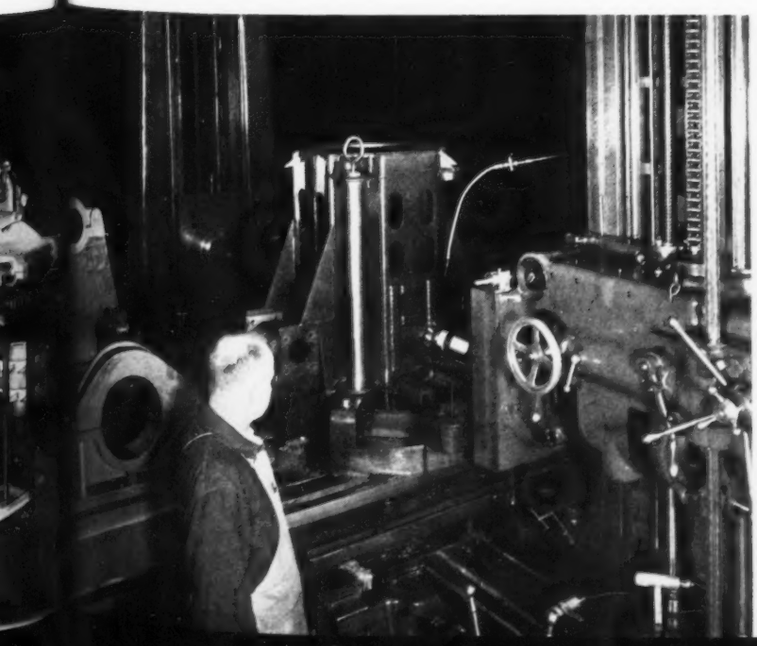


*Fig. 16. Boring a Recoil Cradle for a Gun Mount on Another Horizontal Boring Mill*

# Air Corps Ready

*By MAJOR GENERAL H. H. ARNOLD*
*Chief of the Army Air Corps*

IN April, the President affixed his signature to the bill authorizing the expansion of the Army Air Corps to not more than 6000 airplanes, and in the same month, he signed the Appropriation Act for the fiscal year 1940, which included $50,000,000 to initiate the program to provide for an adequate national defense. By the time this statement is published, the balance of the $300,000,000 recommended by him in his message last January will probably also have been appropriated.

Through the expenditure of these funds the Air Corps will be pyramided by July 1, 1941, to an average strength of 5500 airplanes. This means that some 3000 airplanes are to be contracted for, constructed, tested, accepted, and delivered, and put into operation in various Air Corps squadrons or become part of a rotating reserve in the brief span of twenty-four months.

The Presidential ink had scarcely dried on the parchment, by which the money for the expansion program was made available, before the Assistant Secretary of War had signed contracts obligating a substantial part of the fifty million dollars provided in the current appropriation act and the entire amount was obligated within the next few days. To any one familiar with the intricacies of government procurement, with its involved legal procedure, preparation of specifications, circular proposals and invitations for bids, submission of models by competing manufacturers, study of types, and final decision as to the advisability of purchase of the type selected, this accomplishment may seem little short of miraculous. This quick and decisive action was no miracle, however, but merely foresight inspired by the national need and made possible by the firm belief that the people and the Government of the United States would not suffer the Air Corps defenses to remain insignificant in comparison with those of other nations.

For months the consideration of these appropriations has occupied Congress and its various committees. The question had scarcely been opened as a possibility, however, when Air Corps officers and personnel began to work out the possible procurement procedures for providing the additional airplanes, should, after due deliberations, the bill become a law. As early as last November contracts began to be drawn up on the chance that they would be needed in the new expansion program. In adopting a policy whereby this premature action could be followed through, it was realized that in any swift quantity procurement, the best types of aircraft already in existence would have to be "frozen" for production. That the United States during the years that it had a smaller air force has expended all available funds in the development of aircraft and equipment whose superiority was acknowledged throughout the world made the adoption of such a policy possible.

In the meantime, a survey was made of the various manufacturers' plants in order to gage the production possibilities of each, and to learn the possibilities of success of the greatest peacetime aircraft building program ever to be undertaken in the United States. The aircraft manufacturers and manufacturers of related equipment, not only permitted full surveys of their plants to be made, but cooperated with the Air Corps in placing all their manufacturing facilities at the disposal of the Air Corps for a study of the possibilities. Certain firms which had produced aircraft under Government orders in the past went farther, and taking a gambler's chance that the Air Corps expansion program would be written into law, went to

# *for Army Expansion Program*

the expense of making preliminary preparations in the tooling up of their facilities in preparation for the possible Government production.

All present procurement of Army aircraft is subject to the provisions of the Air Corps Act of 1926. Under this Act and in time of peace, Army airplanes can be procured by three different methods: First, in quantity by open competition; second, as a result of design competition; and third, purchase by negotiation. Under the first method, aircraft is procured by advertising for bids for the type desired, and contracts are awarded, at the discretion of the Secretary of War, to the lowest responsible bidder that can satisfactorily perform the contract to the best advantage of the government. The law does not prescribe any specific period of time that must elapse between the issue of advertisements for bids and the date of opening the bids. The minimum time allowed under the existing policy is usually thirty days, although the time is generally extended.

Under the method of design competition, the minimum time allowed for procurement, as prescribed by law, is ninety days from the date of advertisement and opening of bids. It has also been the policy to allow a much longer time under this procedure, especially when the advertisement calls for the delivery of an article with the bid. Thirdly, for experimental or development purposes, purchase may be made by negotiation. Under this method, no advertisements for bids or other competition are required by law. This method is used when the development must be kept secret, in the interests of National Defense. As soon as such secrecy is no longer necessary, additional lots are purchased by open competition. The maximum number that has been procured under this section is thirteen, the number required for service test.

In time of war or when war is imminent, Section 120 of the National Defense Act contains authority for the President to place orders for such products or material as may be required, and compliance with such orders is made obligatory on the individual, company, or corporation with whom the order is placed.

These methods, while insuring conscientious and valuable development, are time-consuming; hence it has been necessary for the Air Corps to take

*See page 791 for conclusion of this article.*

***Major General Henry H. Arnold, who was appointed Chief of the United States Army Air Corps last fall, was born in 1885. His distinguished aviation career began in 1911, four years after his graduation from West Point. In his second year as an aviator, he gained prominence by becoming the first man to win the Mackay Trophy awarded for excellence as a military pilot. Twenty-two years later he won this trophy a second time as commander of ten Martin bombers that made an outstanding mass flight from Washington, D. C., to Fairbanks, Alaska, and back.***

***General Arnold is also a graduate of the Army Industrial College and the Command and General Staff School at Fort Leavenworth. He has held many important commands. He organized and commanded the aviation defense forces of the Panama Canal Zone, served overseas, has been commanding officer of several air fields and air corps units, and was Assistant Chief of the Army Air Corps from 1935 until his appointment as Chief of the Air Corps.***

★ ★

***MAJOR GENERAL HENRY H. ARNOLD***

# *The Flying Fortresses of*

*Fig. 1. Drilling Bulkhead Assemblies on a Special Machine Equipped with a Drill Head that is Moved Backward, Forward, and Sidewise Over Parts Laid on a Flat Jig*

BEGINNING early this summer a new fleet of Boeing Type B-17 four-engine Flying Fortresses will be delivered to the United States Army Air Corps to supplement the fleet of these aerial defense giants already in service. Ranked as the world's fastest heavy bombardment airplanes, these twenty-odd ton all-metal ships of the air have become the backbone of the Air Corps.

Although detailed performance figures and specifications are kept secret by the Air Corps, these planes are known to have a high speed of more than 250 miles an hour and a range of over 3100 miles. A spectacular accomplishment that proved their speed and long-range efficiency was the recent record-breaking mass flight of six of these planes from Miami, Fla., to Buenos Aires, Argentina. Making but one stop, the bombers flew the 5260 miles in 27 hours 50 minutes flying time.

A Flying Fortress piloted by Lieutenant Colonel Robert Olds also established new non-stop coast-to-coast records for military planes in both directions across the continent. An east-west flight was made from Langley Field, Va., to March Field in Calif., in 12 hours 50 minutes, and a west-east flight in 10 hours 46 minutes. One of the original fleet is equipped with exhaust-driven blowers or

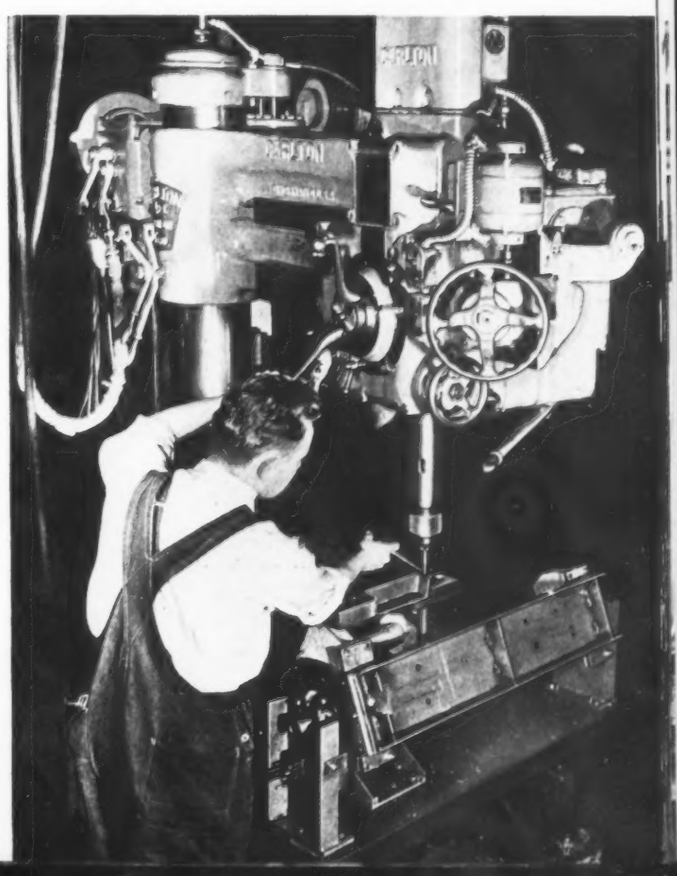
# *the United States Army*

superchargers for feeding air to the engines at approximately constant sea level density, although the airplane may be at an altitude of 20,000 feet.

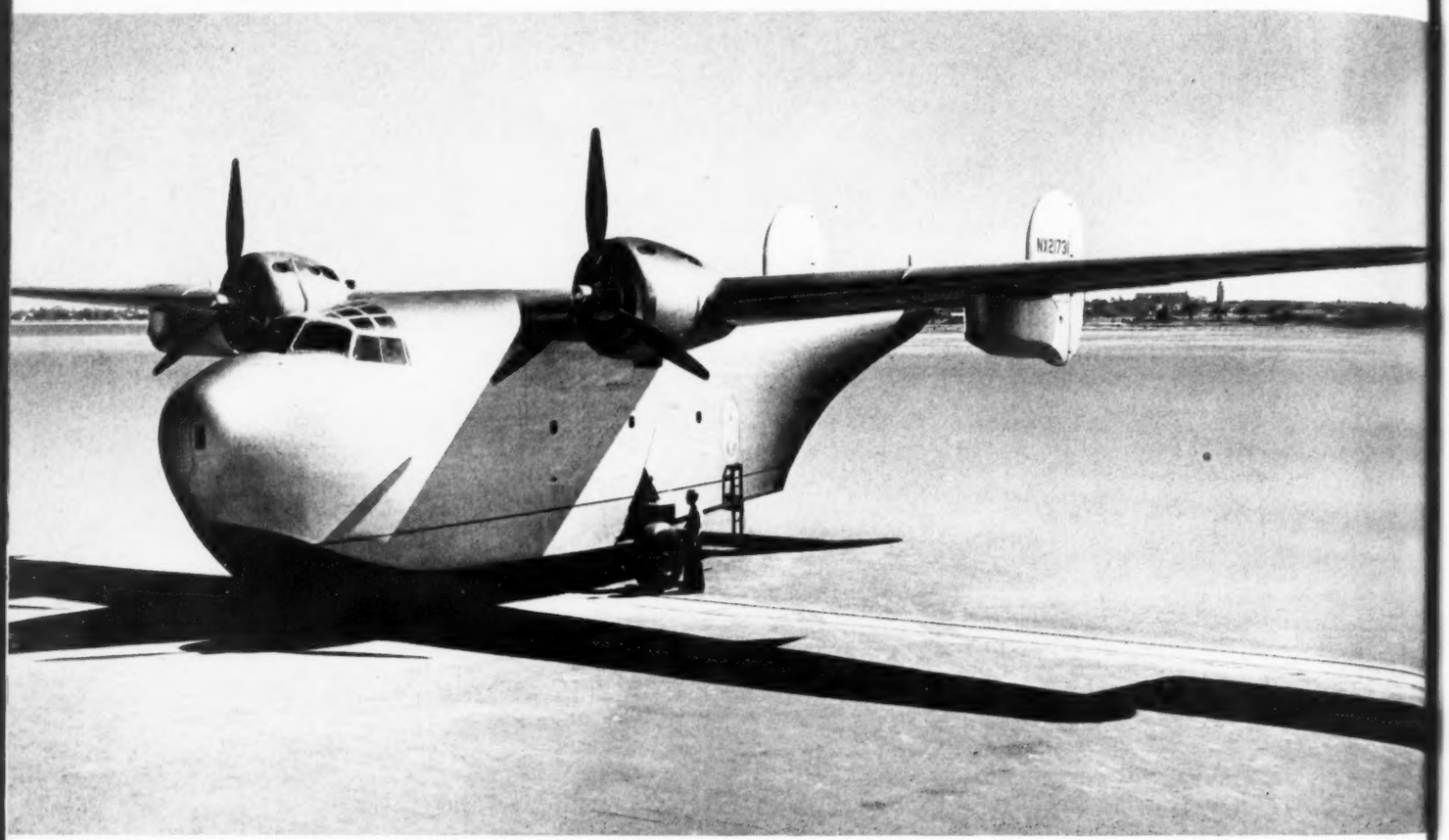
These Flying Fortresses are of a low-wing monoplane design, and are driven by four Wright Cyclone engines of 1000 horsepower take-off rating each. They have a wing span of approximately 105 feet, a length of 70 feet, and an over-all height of 15 feet. Streamlined into the sleek sides of their fuselage are five machine gun emplacements, one of them being located in the nose and the other four in the form of "blisters" at the top, bottom, and sides of the body.

Construction work on these planes at the plant of the Boeing Aircraft Co., Seattle, Wash., is practically all metal-working, as the planes are built almost entirely of aluminum, aluminum alloys, and special steels. Each plane requires the production of 40,000 different parts, all of which must be carefully planned as to process, method of fabrication, sequence of fabrication, assembly, and installation. Work on the new bombers, as well as on the huge Pan-American Clippers and Stratoliner Transports, has sent the Boeing payroll to an all-time high. New machines and advanced methods have supplemented this increase in man power.

*Fig. 2. Radial Drilling Machine being Used in the Boeing Plant for an Operation on a Landing Gear Part for a Flying Fortress. The Machine is Equipped with an Indexing Jig*



# "Wright Aero" Builds the World's



*By CHARLES O. HERB*

THE demand for aircraft engines is attaining remarkable heights as a result of the impressive air defense plans of our own and foreign governments and the ever increasing popularity of commercial aviation. The present year is the biggest in the history of the Wright Aeronautical Corporation, Paterson, N. J., builders of radial aircraft engines, and 1940 appears even more promising. Some manufacturing departments are working twenty-four hours daily, five days a week.

This concern is one of the most progressive in the aircraft industry of the entire world, and is in the limelight at the present time because of the recent announcement of its development of the world's largest and most powerful air-cooled airplane engine, which was accomplished in conjunction with engineers of the United States Air Corps. This engine has a rating of 2000 horsepower. It is constructed with eighteen cylinders, arranged in two rows of nine cylinders each, which drive a common crankshaft. Two engines of this capacity drive the long-range Consolidated flying boat which made a flight about two months ago in which it carried fifty-two passengers and a crew of five.

Some of the equipment installed last year in this engine plant to meet production demands and to achieve the highest possible accuracy consistent with interchangeable manufacture will be described in this article. Approximately $1,000,000 was expended during the year, and the same amount the year previous. All operations described pertain to parts for Cyclone single-row 1100-H.P. engines, the details of double-row engines being kept strictly confidential.

One of the outstanding new machine installations is a battery of large Fastermatics, which machine steel crankcase halves from the rough

# *Largest Air-Cooled Aircraft Engines*

forgings to parts completely finished, except for drilling and grinding operations. These forgings are of a chromium-nickel-molybdenum steel and weigh 164 pounds in the rough. Their weight is only 45 pounds when they leave the Fastermatics. The forgings have a hardness of between 241 and 285 Brinell.

The first operation on the inside of the crankcase half is performed in the machine shown in Fig. 1 after the closed side has been faced and the legs turned externally, also in a Fastermatic. In the operation illustrated, roughing and semi-finishing cuts are taken on all the inner surfaces. In the taking of wide facing cuts, tools on the turret are fed across the work by a plunger on the rear cross-slide. Chips are cut as heavy as 1 1/8 inches wide by 0.015 inch thick.

After the crankcase halves have been completely turned and faced by the Fastermatics and drilled on another type of machine to enable the two halves to be assembled, they are returned to the machine illustrated in Fig. 2 for rough- and finish-boring each cylinder bore, chamfering these bores, and facing the surrounding pads. The nine cylinder bores are machined by this Fastermatic in about 50 per cent of the time formerly required.

The pad facing cuts are taken by a tool on a slide that is mounted on the chuck and is fed radially after the boring tools have reached the end of their movement. Dimensions of surfaces turned by the Fastermatics are held generally to tolerances of plus or minus 0.003 inch, while the hub bore diameter must be maintained within plus or minus 0.001 inch. These machines are equipped with hydraulically actuated turrets and air-operated chucks.

Thirty-six breather holes of 3/4 inch diameter are drilled around each crankcase half by means of the Natco drilling machine illustrated in Fig. 3, which is equipped with a nine-spindle head that drills a similar number of holes with each down feed. During the return upward movement, the work fixture is power-indexed to position the part for the next down feed of the head. These breather holes are held to specified center distances within 0.002 inch. To expedite loading, the work fixture is slid on ways to the left-hand end of the machine base through the operation of an air cylinder.

Arter grinders are used for finishing various flat surfaces on the two sides of the crankcase halves and also a pilot diameter on one side. In Fig. 4, a machine of this type is seen finish-grinding the top of the nine legs to a dimension that must be held within plus or minus 0.001 inch. The wheel-slide is reciprocated hydraulically.

A thin ball-bearing ring of steel, assembled into the bore of the crankcase half, is ground in a Bryant chucking grinder, as shown in Fig. 5. The internal diameter of this ring is held within plus or minus 0.0005 inch. The same machine is also used previously for grinding the main bearing bore into which the ball-bearing ring is assembled, as well as for grinding the smaller oil-seal bore.

At the same time as the main bearing bore is ground, a face at the back of this bore is ground for a width of 1/2 inch, square with the bore. This

*Fig. 1. Roughing a Steel Crankcase for a Wright Engine on a Fastermatic*

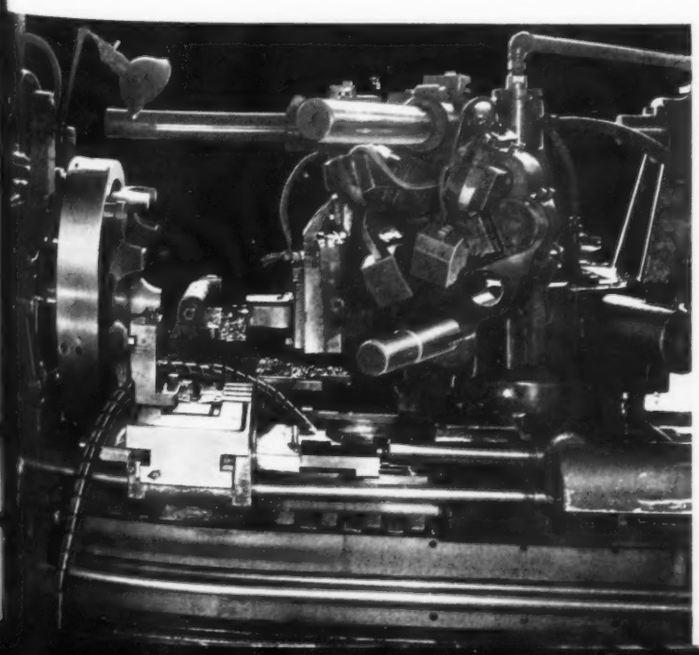
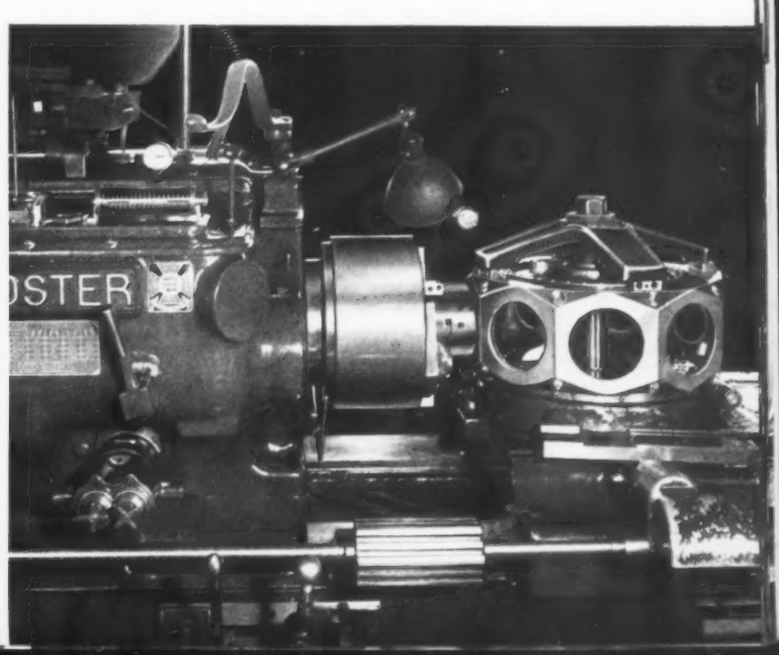


*Fig. 2. Boring and Facing the Nine Cylinder Barrel Pads on an Assembled Crankcase*



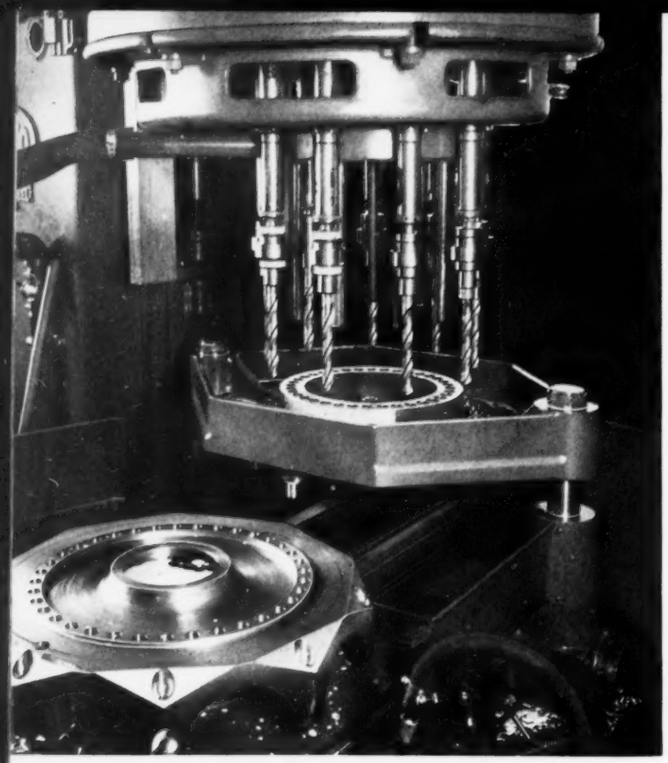


*Fig. 3. Drilling Thirty-six Breather Holes, Nine at a Time, in Crankcase Halves*

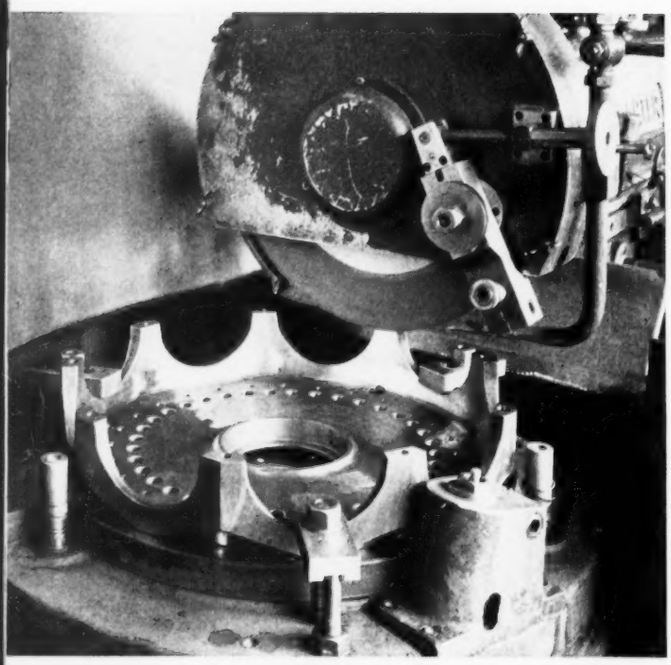


*Fig. 4. Grinding Machine Used for Finishing Surfaces on Both Sides of Steel Crankcases*

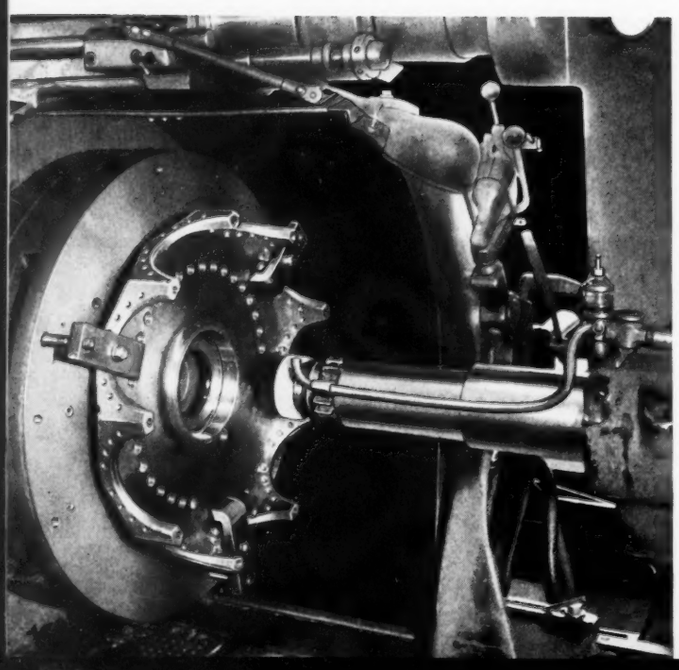


*Fig. 5. Internal Grinding Operation on a Ball-race Ring Inserted in a Crankcase Half*

is accomplished by the use of a form wheel. Work from 1 to 20 inches in diameter can be accommodated.

The crankpin end of master connecting-rods is milled to the required contour by the heavy-duty Sundstrand rotary milling machine shown in Fig. 6. In this operation, a cutter 4 1/2 inches in diameter by 3 inches wide is fed hydraulically toward the work fixture until a roller above the cutter comes in contact with a profile plate or templet mounted above the work. Then, as the work revolves the cutter-head moves back and forth according to the contour of the profile plate, being pushed back by the profile plate at the several corners and permitted to advance under the hydraulic pressure between the corners. Stock up to a maximum of 3/4 inch deep is removed. The master rod seen on the machine is approximately 20 inches long. It is bored and faced prior to the milling operation and located from the finished surfaces for milling.

The Wright Aeronautical Corporation has been a staunch advocate of the thread grinding of cylinder hold-down studs, adjusting screws, rocker hub bolts, and crankcase clamp screws. This concern has now carried thread grinding a step farther by adopting it for finishing the modified buttress threads on cylinder barrels, which serve the purpose of securely holding the screwed- and shrunk-on cylinder heads. These cylinder-barrel threads are first milled in Lees-Bradner machines, as shown in Fig. 9, within a pitch diameter tolerance of 0.002 inch and with the thread concentric in relation to a cylindrical pilot surface within 0.001 inch. The basic pitch diameter of the threads on the barrel shown is 6 9/16 inches; there are six threads per inch.

Grinding of the cylinder-barrel threads is performed both in the Ex-Cell-O machine illustrated in Fig. 7 and in the Jones & Lamson machine shown in Fig. 8. The practice is to remove 0.017 inch of stock on the diameter, the entire thread contour being ground by the form wheel in one pass of the wheel across the thread. At the end of this operation, the wire reading across the threads must be as specified within plus or minus 0.0005 inch. Grinding has been adopted for the finish-

*Fig. 6. Milling the Crankpin End of Master Connecting-rods, Using a Profile Plate*

*Fig. 7. Ex-Cell-O Thread Grinding Machine Finishing the Thread on Cylinder Barrels*

*Fig. 8. Jones & Lamson Machine Grinding the Buttress Thread on Cylinder Barrels*

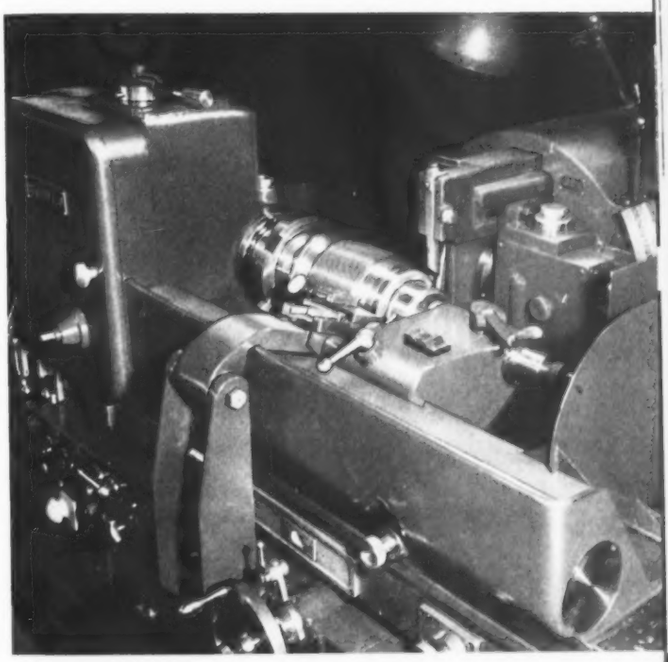
ing of these cylinder-barrel threads in order to insure a uniform fit between the barrel and head of each cylinder assembly on the engine within close limits.

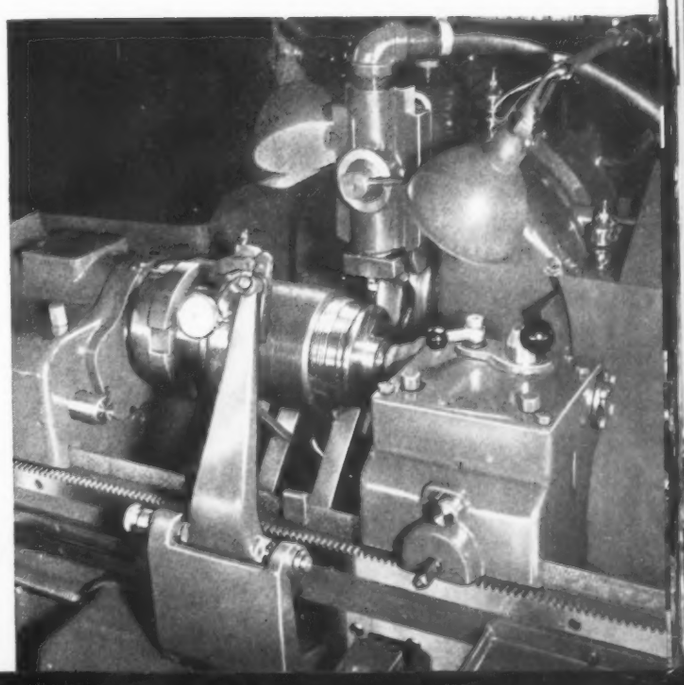
Substantial savings have been effected in producing reduction pinion blanks through the installation of Potter & Johnston No. 4D automatics, one of which is shown in Fig. 10. In a roughing operation performed on one of these machines, a series of turning and facing cuts is taken on the dome end and a 1/2-inch hole is drilled the full length of the part.

The pinion forging is then transferred to the machine shown for taking rough and finish turning, facing, and boring cuts on the hub end, and also performing recessing and tapping. On the turret faces shown toward the front of the machine may be seen the tools employed for turning the gear blank diameter and machining the deep recess between the hub and the gear rim. At the end of this operation, the part is returned to the first automatic for finishing the dome side. The two machines finish these pinion blanks in one-third the time required by former methods.

Another Potter & Johnston 4D automatic recently installed for finishing the pin holes and bosses of pistons is shown in Fig. 11. Tools on the first face of the turret rough-bore both holes in line, the cutter-bar being moved upward after the front tool has entered the piston. This is accomplished by a roller at the top of the turret-slide engaging a slot in a cam-block mounted at the front end of the headstock. Tools on the second face of the turret chamfer the outer end of both holes, these cuts also being taken by the tool-slide being pulled upward through the engagement of a roller with a second cam slot on the headstock, positioned at an angle of 12 degrees for obtaining the desired angle of chamfer.

The inside faces of the piston bosses are next faced by tools on the third side of the turret, which are fed crosswise by a block on the cross-slide pressing against the tool-slide on the turret. The piston-pin holes are then semi-finish bored by tools on the fourth turret face, which are moved upward in the same manner as the rough-boring tools, after which recesses are cut in the





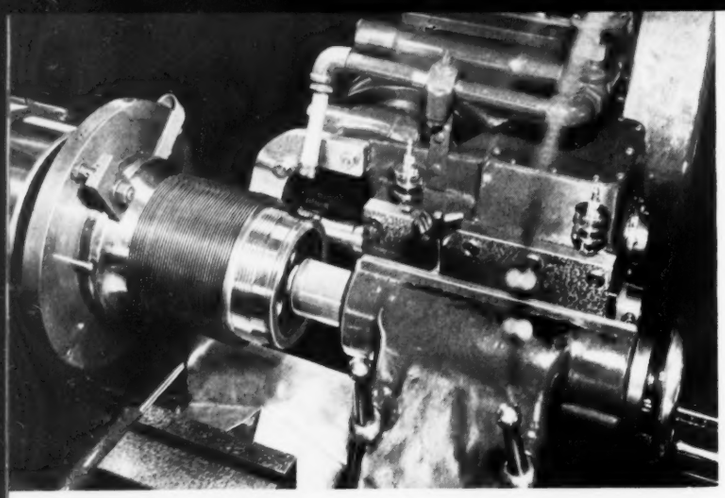


*Fig. 9. Milling a Modified Buttress Thread on a Cylinder Barrel Prior to Grinding*

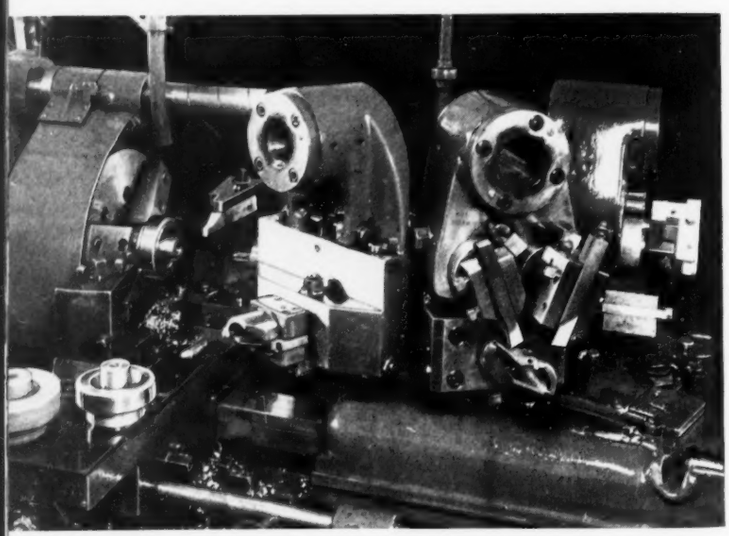


*Fig. 10. Machining Reduction Pinion Blanks in a Potter & Johnston Automatic*

piston-pin holes by tools on the fifth turret face. These tools are operated horizontally by the cross-slide in the same manner as the facing tools on the third turret face. This one machine turns out pistons as rapidly as three previous machines.

Internal splines are ground in large reduction gears, as shown in Fig. 12, in a machine built by the Gear Grinding Machine Co. These splines are of the involute type, of 6.768 diametral pitch, and have a pressure angle of 30 degrees. The twenty-four teeth must be accurate as to spacing within 0.0005 inch, and the tolerance on the pitch diameter is 0.001 inch.

These splines are first rough-cut on a Fellows gear shaper, and then ground, as illustrated, with a 3 1/2-inch form wheel. From 0.008 to 0.010 inch of stock is removed from the spline teeth in grinding. The work is reciprocated hydraulically along the wheel, and is indexed during the return movements. The splines are ground twice around.

Fig. 13 shows internal threads being milled in propeller shafts on a Lees-Bradner machine. In the operation shown, the thread has a nominal diameter of 2 7/8 inches, and there are sixteen threads per inch. The "Go" gage dimension for the pitch diameter is 2.8344 inches and the "No Go" gage dimension, 2.8376 inches. In addition to the thread, the cutter finishes a plain surface, 1/2 inch wide, in front of the thread.

Two chucks, one of them of a rotary type and the other a conventional magnetic chuck, are provided on the Thompson hydraulic grinding machine shown in Fig. 14, which is employed for grinding surfaces on both cheeks of crankshafts. In grinding the flat outer cheek, the shaft portion of the part is inserted in bushings in the rotary chuck, as seen at the left. The operation is then performed by the reciprocation of the regular table of the

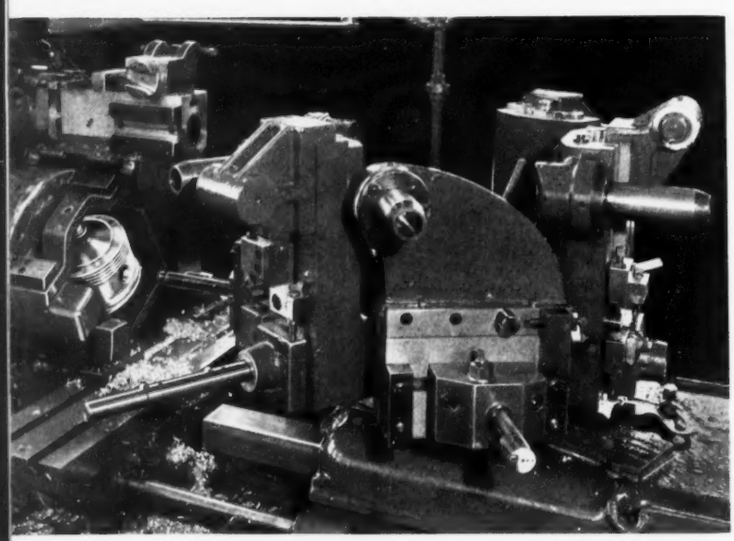


*Fig. 11. Potter & Johnston Automatic Machining Piston-pin Holes and Bosses*

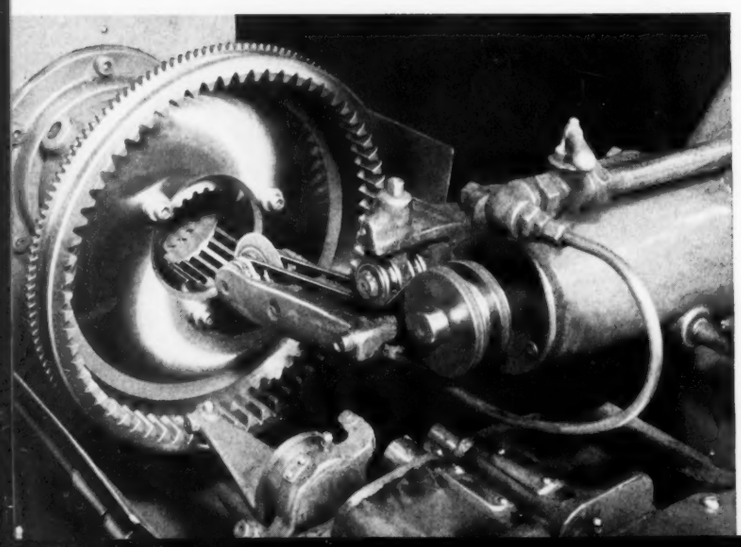


*Fig. 12. Finish-grinding Involute Splines in Large Reduction Gears*

*Fig. 13. Milling Threads and a Plain Cylindrical Surface in Propeller Shafts*

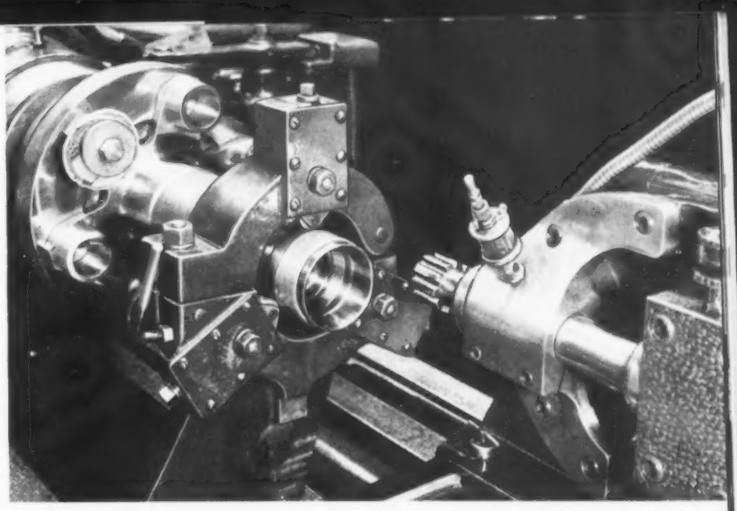
*Fig. 14. Hydraulic Surface Grinder Equipped with Both Rotary and Magnetic Chucks*

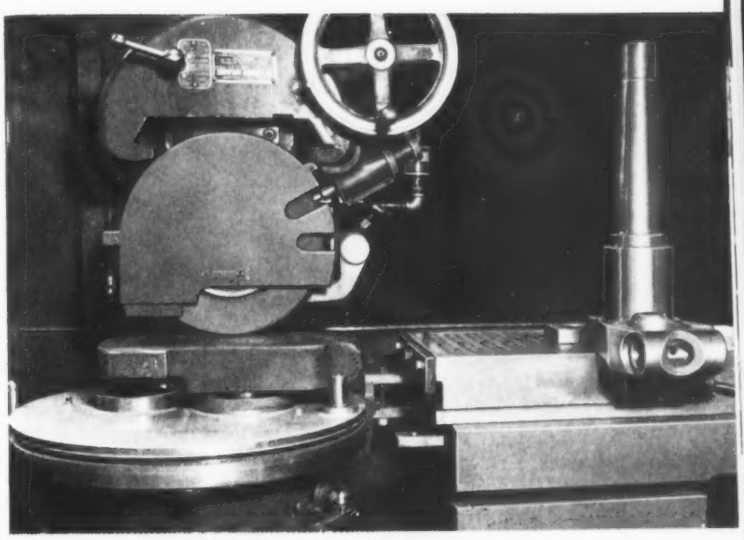
machine, which carries the work back and forth beneath the grinding wheel. The rotary action of this chuck is used in certain operations, as in grinding part way around a hub, in which case the chuck is oscillated to the right and left.

The magnetic chuck is used for holding crankshafts in grinding flat surfaces on the inside cheek, in which case the work is positioned on the chuck shown at the right. Limits of plus or minus 0.0005 inch are maintained in finish-grinding.

Both climb and conventional milling are performed by the DeVlieg machine illustrated in Fig. 15, which is shown engaged in finishing slotted arms on the rear ends of crankshafts. An area about 3 inches square is finished on one surface of each part as the table feeds from left to right, and on the opposite arm of each part as the table returns to the left. At the end of this operation, the width of the slot must be 0.807 inch within plus nothing minus 0.005 inch, and the thickness of one arm must be to the specified dimension within plus or minus 0.002 inch. When these parts reach the milling machine, the arms are solid. They are first hobbed out and then finish-milled.

All crankshafts for Wright engines are checked for balance in the Gisholt Dynetric machine illustrated in Fig. 16, and the necessary corrections are made by drilling. Before a crankshaft can pass the inspectors, it must be in balance within 1 ounce-inch, as indicated by the machine, this being equivalent to 1/200 pound at the radius of the crankpin. Balance is checked in both ends of the work by merely operating electrical switches. Any unbalance in the crankshaft assembly causes the rests on which the assembly is supported to vibrate and produce changes in the resistance of electrical circuits. Corresponding readings on the panel board show the location and amount of unbalance.





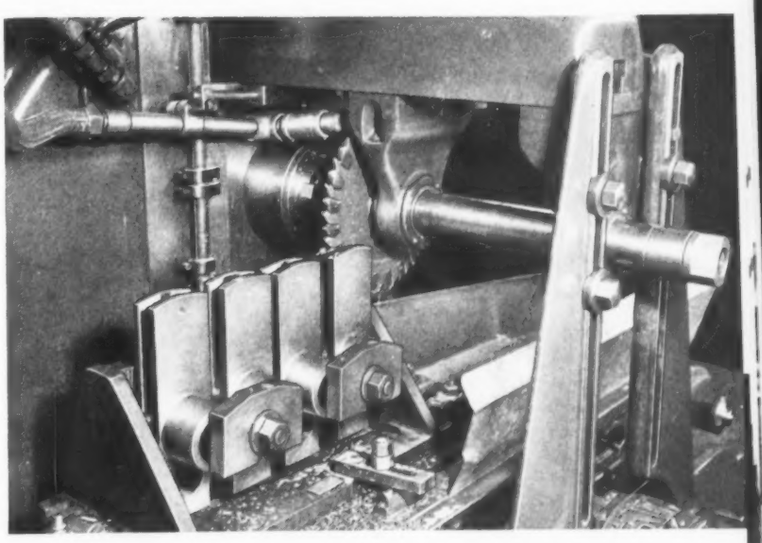


*Fig. 15. An Operation in which Conventional and Climb Milling are Both Performed*

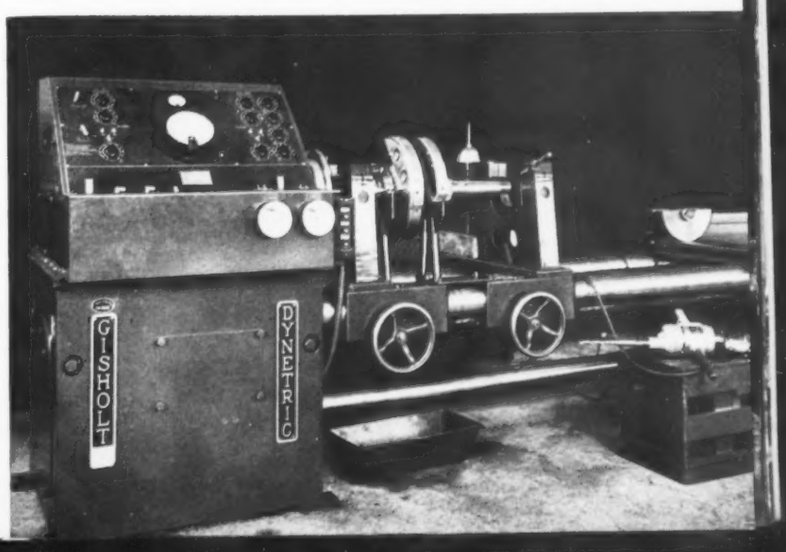



*Fig. 16. Machine Used in Balancing Crankshaft Assemblies within 1 Ounce-inch*

# *Honing in*

*By KIRKE W. CONNOR*
*President*
*Micromatic Hone Corporation*
*Detroit, Mich.*

REMARKABLE advances have been made in the performance of aircraft engines during the last decade. The horsepower output per liter has been increased 94 per cent; speed, 50 per cent; and operating periods between overhauls, 100 per cent. Honing has made important contributions to this progress by providing an accurate control of dimensions, permitting closer tolerances on parts, minimizing the fatigue of metal induced by preceding machining operations, and providing a very smooth finish that is favorable to the most efficient lubrication of important bearings.

The cylinders of straight-line water-cooled engines, as well as the majority of radial engine cylinders, are being finish-honed. In a typical operation on radial engine cylinders of about 350 Brinell, approximately 0.0015 inch of stock on the diameter is removed from a ground finish in one honing operation in a floor-to-floor time of approximately 14 minutes. Roundness and straightness are produced within 0.0003 to 0.0005 inch.

Nitralloy cylinders having a hardness in excess of 800 Brinell are also finish-honed in one operation, approximately 0.001 inch of stock on the diameter being removed from a ground finish in a floor-to-floor time of 19 1/2 minutes. The error with regard to roundness and straightness seldom exceeds 0.0004 inch, and the honed surface has a smoothness within 1.8 and 2.5 micro-inches, as determined by profilometer readings.

Four honing machines used for finishing cylinder barrel assemblies are shown in the heading illustration. The clamping fixtures are provided with separate split type bushings that are inserted in the open end of the cylinder barrels to guide the honing tools into the work.

Practically all radial type cylinders are honed after the heads have been assembled on the barrels, thus forming a blind-end type of bore. The heads are machined to a slightly smaller diameter than the barrels, and are heated prior to screwing on the barrels, so as to create a "choked" bore. It is claimed that, in operation, the engine temperature causes the head and top of the bore to expand to a normal bore diameter, so that straightness of the cylinder wall is obtained. There are, however, instances in which the cylinder barrels are honed prior to shrinking on of the heads. The advantage of honing the cylinder walls of aircraft engines includes prolonged ring life, prevention of blow-by and ring flutter, and increase of compression.

In Fig. 1 is shown a close-up view of a machine equipped for honing cylinder barrels. This machine is so designed that the operator can control the number of spindle revolutions during a dwell period of the hone at the blind end of the bore for the purpose of removing all excess stock and obtaining a straight cylindrical bore. Cap-screws are used to hold the flange of the cylinder assembly against the top plate of the fixture. The fixture can be tilted as shown for reloading, a drop-in pin being used to lock it in the working position, as illustrated in Fig. 2.

Badly worn cylinders are honed without any correctional regenerating operation such as grinding. As much as 0.015 to 0.020 inch of out-of-roundness and taper have been corrected in reconditioning operations within an accuracy of 0.0003 inch. The stock removal ranged from 0.010 to 0.025 inch on the diameter.

Some engineers in the aircraft industry maintain that all processing marks in newly finished bores should be parallel longitudinally, it being claimed that this permits the closest possible mating of surface irregularities on moving parts and on the cylinder wall. The advantage of such a

condition would be the minimizing of oil consumption and blow-by on initial runs. Considerable effort has, therefore, been directed toward developing a method of obtaining this type of finish.

Fig. 2 shows a machine equipped with a straight-line lapping tool for this purpose, this tool being used in a third operation after rough- and finish-honing. Cast-iron laps are mounted in conventional stone-holders and impregnated with an abrasive paste. A stroking motion only is imparted to the tool, provision being made for indexing it in such a way that each tool is made to overlap its previous path. Approximately twenty-five indexings are necessary for one complete rotation of the tool. The laps have a tilting or rocking action in the stone-holders and are thus free to seat themselves against the walls of the bore.

Several manufacturers have adopted honing as a final finishing process for the crankshaft and knuckle-pin bores of master connecting-rods of the solid or one-piece type. These rods have a hardness of from 331 to 375 Brinell, and are ground in the holes previous to honing. A close-up view of the tool and fixture equipment required for honing a crankshaft bore is shown in Fig. 3. Accurate location and alignment of the work are obtained by means of quick-acting plugs. Full lateral float is provided, and adjustment for variations in the width of the master rods is obtained through the elevating handle at the wrist-pin end of the fixture.

The wrist-pin bores of master connecting-rods can also be honed in this machine by changing the tools and guide bushings, indexing the table, and providing a locating plug for the crankshaft bore.

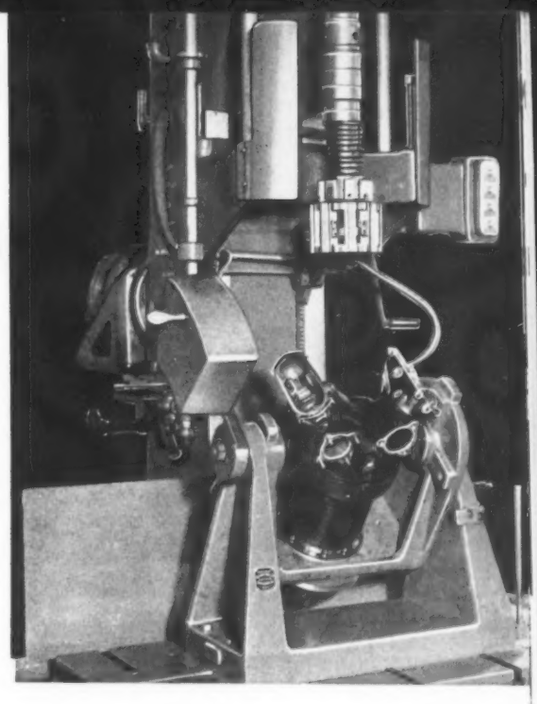


*Fig. 1. Honing Machine Employed for the Reconditioning of Cylinder Assemblies for Radial Aircraft Engines*

Crankshaft bores 3 1/2 inches in diameter by 3 1/4 inches long are finish-honed in one operation from a ground finish in 8 minutes. From 0.0005 to 0.0007 inch of stock on the diameter is removed and an accuracy of between 0.0002 and 0.0003 inch is obtained for roundness and straightness. Some crankshaft bores are chromium-plated after honing and then rehoned, the purpose of the first honing operation being to eliminate fatigue cracks and insure a uniform thickness of plating. In the second honing operation, from 0.0003 to 0.0004 inch of stock is removed on the diameter in 8 minutes. The final surface finish has a smoothness of between 1.7 and 2 micro-inches, and the accuracy is within 0.0003 inch. (This article will be concluded in a coming number of MACHINERY.)

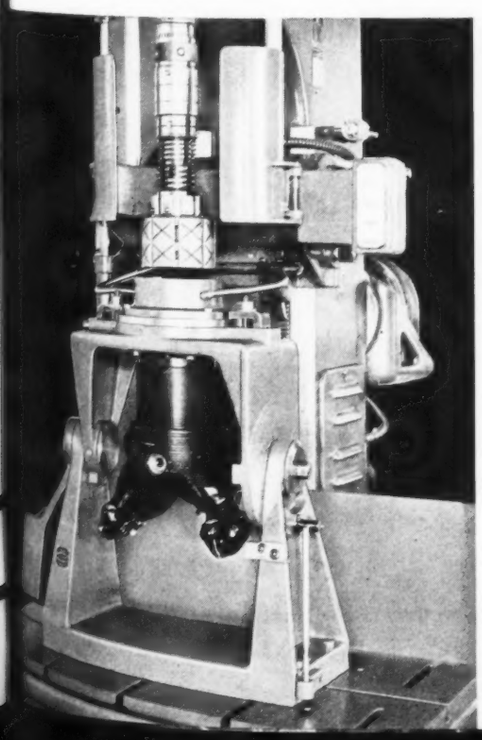


*Fig. 2. (Left) Another View of the Machine Seen in Fig. 1 Equipped with Cast-iron Laps that are Used after Finish-honing*

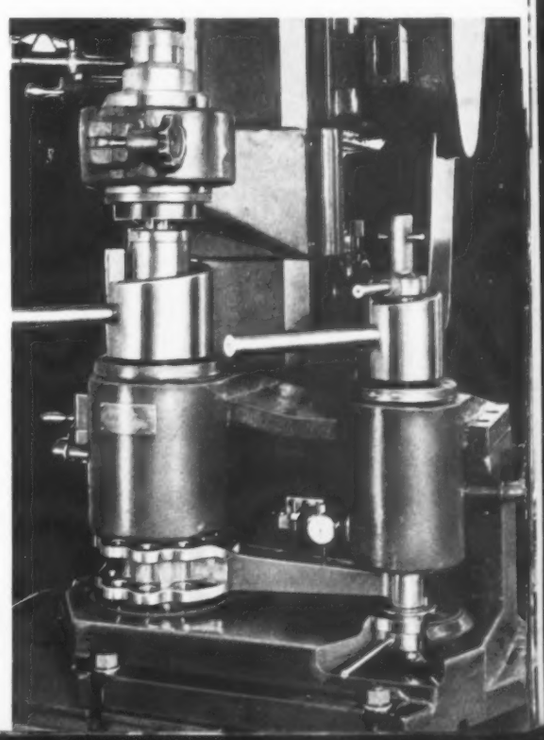


*Fig. 3. (Right) Honing the Crankshaft Bore of a Master Connecting-rod of the Solid Type*

# "Master Gears"

*By CHARLES O. HERB*

GEARS made so accurately that any errors in the involute curve of the teeth do not exceed two ten-thousandths inch and the cumulative error in the spacing of the gear teeth does not exceed three ten-thousandths inch can be truly classified as "master gears." Gears for the engines produced by the Pratt & Whitney Aircraft Division of the United Aircraft Corporation, East Hartford, Conn., must meet these extreme specifications. The unusually close limits are specified to insure the best possible conditions of tooth contact—conditions that are highly desirable because of the fact that airplane engine gears are loaded to their limit in an effort to keep down the weight of the engines to a minimum.

The production of gears is, therefore, one of the most important processes in the manufacture of airplane engines, especially in view of the fact that a Pratt & Whitney double-row radial air-cooled engine has as many as forty-five different gears. Most of the gears are of the spur type, although there are several bevel gears and two helical gears. Airplane engine gears range up to 12 1/2 inches outside diameter and from 16 to 5 diametral pitch.

Practically all the teeth on these spur gears are ground, not only on the involute curves, but also on the tops or outside diameter of the gear. Those gear teeth that cannot be ground because of the proximity of shoulders are lapped, and the gear teeth that are ground are also lapped in order to obtain the high degree of finish demanded.

Accuracy to the degree specified is especially hard to obtain in this class of work because airplane engine gears must be designed to have minimum weight. The webs are as thin as 3/32 inch, and they are generally drilled through to reduce the weight. In order to avoid excessive distortion in hardening, especial care is taken during the machining process not to remove so much stock with any one tool as to set up severe internal stresses. Also, the gear blanks are normalized after they have been rough-turned. After being finish-machined, the gears are carburized and then

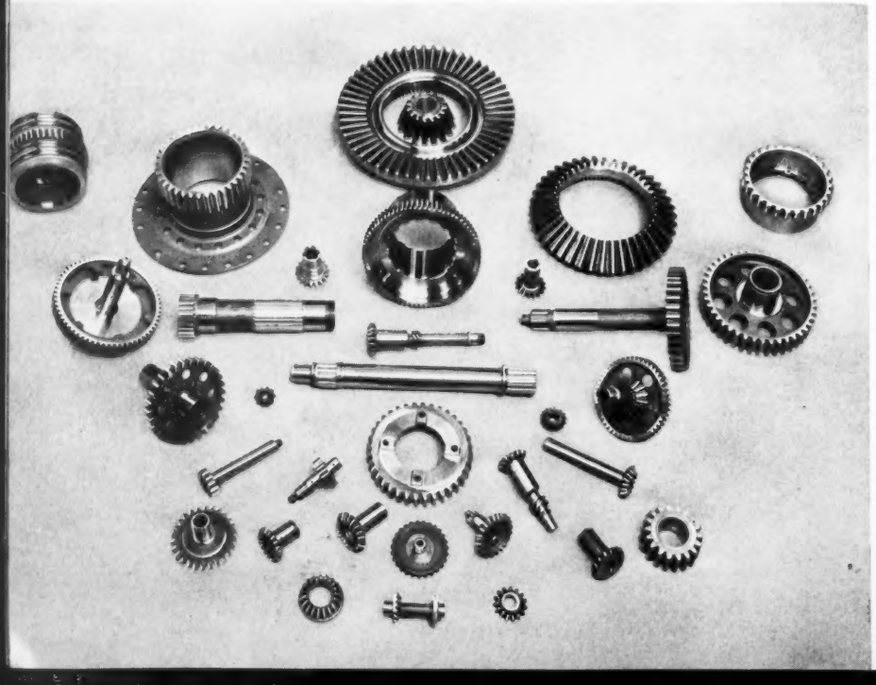


*Fig. 1. Some of the Forty-five Different Types of Spur, Bevel, and Helical Gears Needed for a Single Pratt & Whitney Airplane Engine*

the teeth are cut. Hardening and tempering follow, and then grinding, lapping, and inspection. Gears of ribbed design are hardened in Gleason quenching presses to minimize distortion.

When the gears reach the inspection benches, not only the gear tooth surfaces but the webs, hubs, etc., must be completely free from scratches, tool marks, or burrs, so as to avoid any possibility of gear failure in service resulting from what would ordinarily be considered flaws of no consequence. It is the practice to buff every gear surface, except the teeth, in order to remove all marks.

All gears must pass stringent inspection requirements before being sent to the engine assembly department. The first spur gear in each lot of twenty-five is inspected for the accuracy of the involute curves on each tooth in a Michigan gear-tooth checker. Two of these gears are then run together on a Fellows Red Liner to determine velocity changes or variations in the center distance of the gears due to eccentricity or errors in tooth spacing and shape. Two production gears are run together instead of one production gear and a master, in order to magnify any errors.

The chordal thickness of gear teeth is determined by wire measurement, readings being taken over pins placed between diametrically opposite teeth and a corresponding calculation made. All gears are run together on a Sauer testing machine to check eccentricity. Bevel gears are inspected for tooth contact on a Gleason machine.

Turret lathes are used for the roughing operations on the gear blanks. In these operations, limits of plus or minus 0.004 inch are customary. The gears are made from S A E 2515 steel, either forgings or bar stock. A typical roughing operation on a new Warner & Swasey turret lathe is illustrated in Fig. 2. It consists of turning and facing the gear end of an impeller gear sleeve after the shank end has been machined. To avoid tool marks on the machined shank, a split bushing is slipped over the shank, the bushing being gripped by the chuck jaws.

At the time that this photograph was taken, three tools on the turret were turning the upset head of the forging, each tool cutting to a depth of about 1/8 inch. The tool-head is supported firmly by an overhead pilot-bar which enters the headstock. Tools on the square turret are used for facing the upset head and turning shoulders in

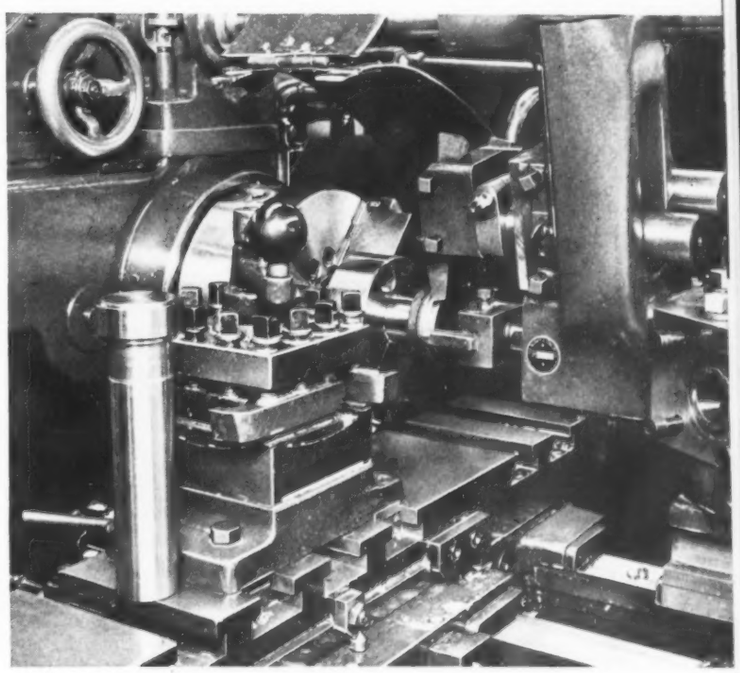
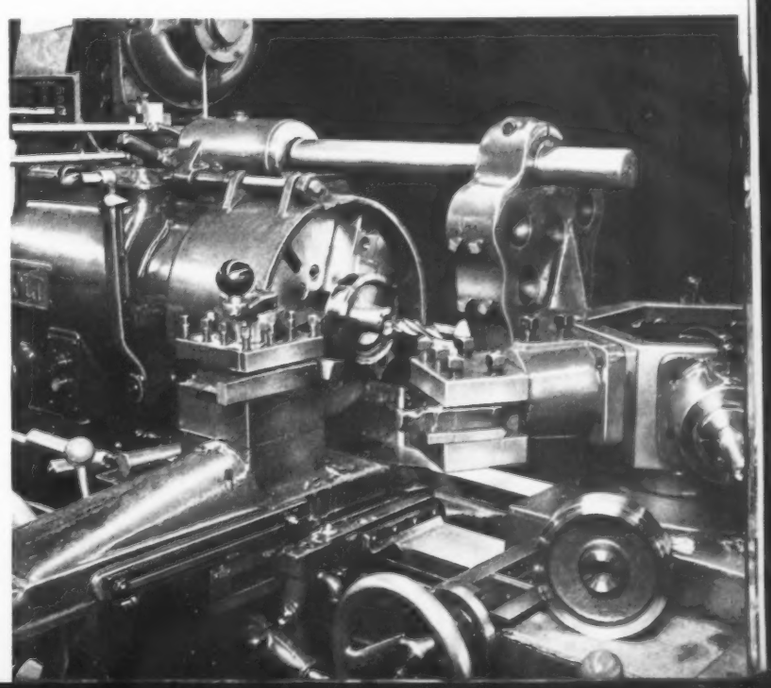


*Fig. 2. Rough-turning the Upset End of an Impeller Gear Sleeve in a Turret Lathe. Three Cuts being Taken Simultaneously*

*Fig. 3. Another Turret Lathe Operation in which an Accessory Drive Gear is Machined within Limits of Plus or Minus 0.003 Inch from a Rough Forging*



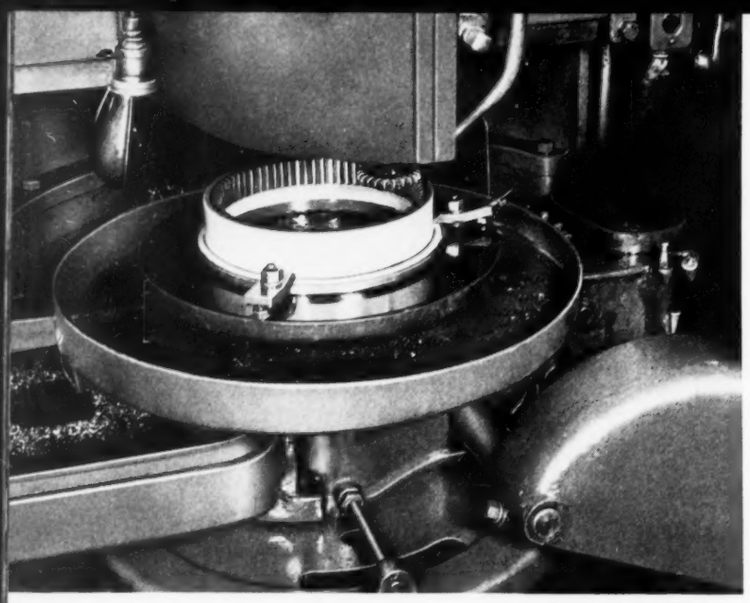


*Fig. 4. Cutting the Teeth in a 12-inch Internal Gear on a Fellows Gear Shaper*

front and back of the head, as well as turning a recess about 1 1/4 inches long, as seen on the part that stands at the front of the cross-slide. The long shank on this part is turned by a tool on the square turret in the previous operation referred to. Tungsten-carbide tools are used in both of these operations.

At the end of these operations, the impeller gear sleeve is normalized and carburized, after which it is drilled the full length on a Pratt & Whitney deep-hole drilling machine. Then the part is returned to the Warner & Swasey turret lathe for boring and reaming. After the gear teeth have been hobbed, the hole is ground to size within 0.0003 inch for diameter and straightness. This operation is performed solely to obtain accurate balance, because the hole clears the shaft that passes through it when the part is assembled.

Fig. 3 shows an accessory drive gear being rough-machined in a Gisholt turret lathe, an operation in which turret tools drill, bore, and ream the hole and face the web while tools on the square turret turn the large gear diameter and the hub, and face the sides of the gear rim and the end of the hub. Both roughing and finishing cuts are taken, the outside diameter of the gear blank being 6.222 inches within plus or minus 0.003 inch when the part leaves the machine. Tungsten-carbide cutters are used on the square turret. Pilot-bars steady the turret tools in taking the drilling and boring cuts.

Machines of conventional types are employed for cutting the spur and bevel gears. For example, a Fellows gear shaper is shown in Fig. 4 cutting the teeth in an internal gear about 12 inches in diameter; a Barber-Colman machine is illustrated in Fig. 5 hobbing a reduction drive pinion; and a 12-inch Gleason generator is shown in Fig. 6 cutting a large bevel gear. In hobbing gears of narrow face width, as many as four gears are mounted on the arbor at one time; when two gears are cut on one part, the larger gear is cut first and the second gear in relation to the larger.

The method of cutting small helical gun-control gears illustrated in Fig. 7 is unique, the operation being performed in a Pratt & Whitney thread milling machine, as two shoulders on the part are too close to the helical gear to permit hobbing in the customary way. In fact, a gear-cutter of special diameter is required on the thread milling machine to avoid cutting into the shoulders. In producing the helical teeth, a roughing cut is taken within 0.002 inch of the finished depth and the remaining stock is removed in a second cut with the same

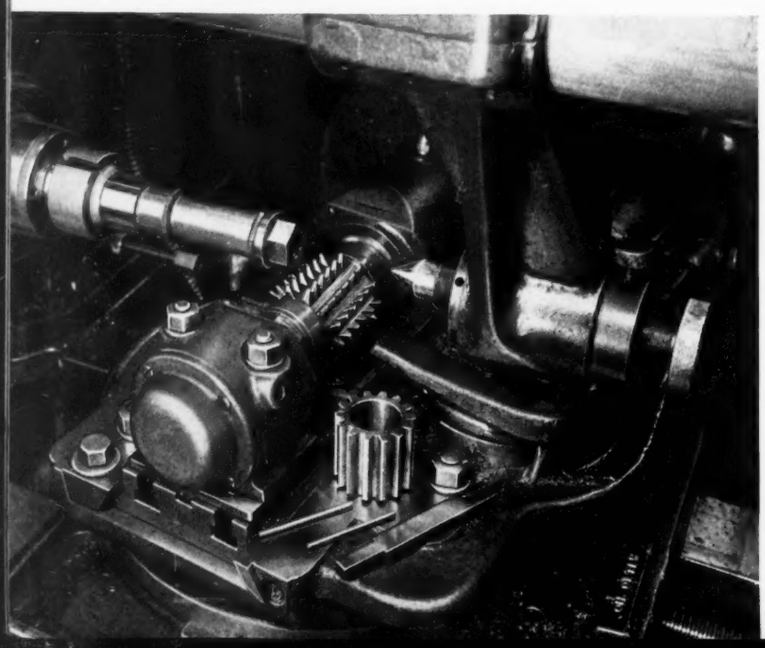


*Fig. 5. Typical Set-up for Hobbing a Reduction Drive Pinion for an Airplane Engine*

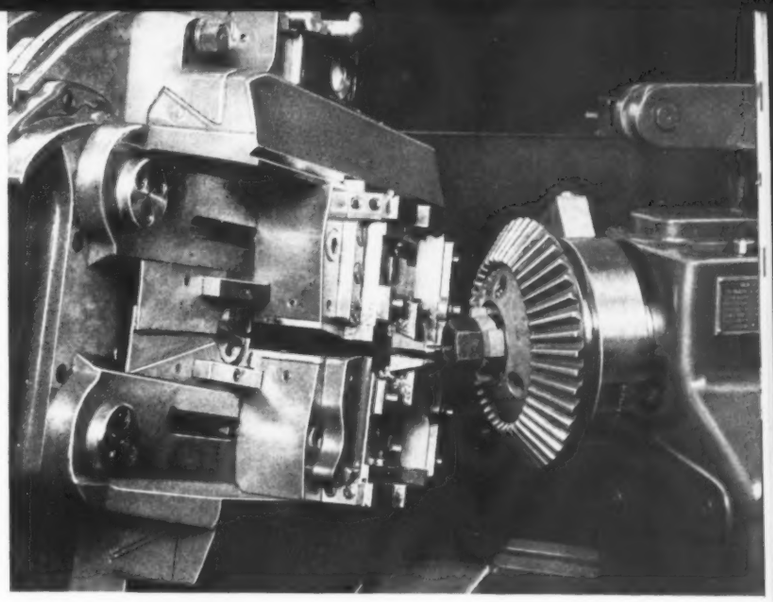


*Fig. 6. Twelve-inch Bevel Gear Generator Set up for Cutting Teeth on a Large Gear*

set-up. The helical gear on the part shown has four teeth of 12 normal diametral pitch and a spiral angle of 45 degrees. When ground, the outside diameter of this gear must be 0.998 inch within plus 0.0005 inch minus 0.002 inch. Both the helical and bevel teeth are polished after hardening. The tolerance across pins placed in the helical teeth is 0.0007 inch.

After the gears have been hardened to between 50 and 60 Brinell, the tops of spur gear teeth are ground in machines of the cylindrical type. Fig. 8 shows such an operation being performed in a Norton 10-inch grinder on the impeller gear sleeve. Outside diameters are held within plus or minus 0.001 inch.

The teeth of spur gears having face widths up to 1 1/4 inches are ground on Pratt & Whitney two-wheel hydraulic gear-tooth grinders of the type shown in Fig. 10, equipped with wheels 20 inches in diameter. One side of each wheel is dressed to a cone corresponding to the flat-sided basic rack that is the origin of the involute system. Thus, the desired involute curve is ground on the teeth as the gear is rolled back and forth beneath the two wheels through the action of a master rack and gear at the front of the machine. The adjacent sides of two teeth are ground simultaneously. Each time that the gear rolls out of engagement with the grinding wheels it is indexed for the next reciprocation.

The practice is to remove from 0.004 to 0.006 inch of stock from each side of the gear teeth in three or four complete indexings of the gear beneath the grinding wheels. The gear shown being ground has thirty teeth of 7/9 diametral pitch. Gears of a greater width than 1 1/4 inches and splines of the involute type are ground on Pratt & Whitney single-wheel machines. The gear-tooth grinders are all equipped with Sorwal filters for the coolant.

Splines ground in the same department on gear parts are also held to extremely close tolerances. On one gear having a shaft with involute splines, the press fit allowance between the shaft and the part with which it mates is only 0.0005 inch, and the spline dimensions must be held within 0.0001 inch. Square splines are being ground on the impeller gear sleeve in the operation shown in Fig. 9, which is being performed on a Fitchburg machine. The adjacent sides of two splines are ground simultaneously, the usual practice being to grind around the work three times. In the first grind, the splines are brought to the specified width within about 0.008 inch; in the second grind within

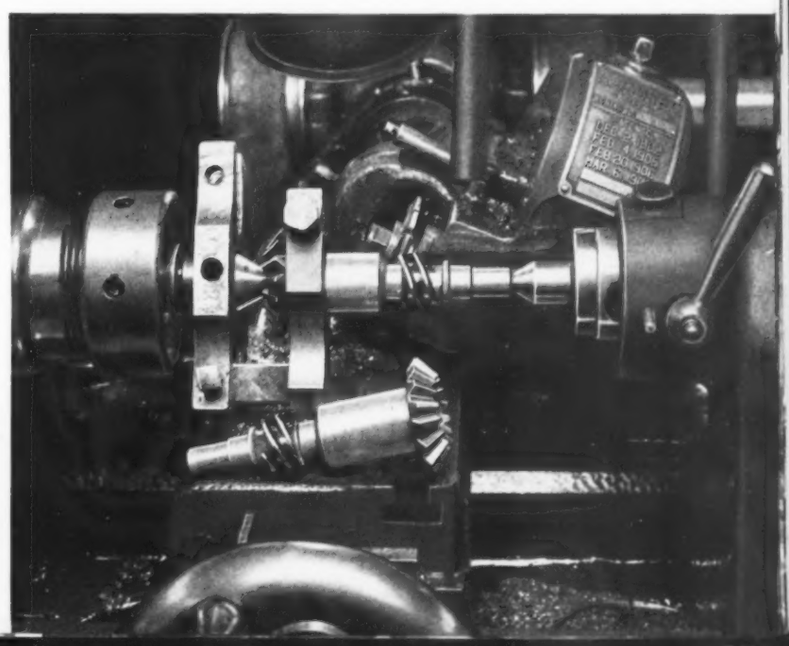


*Fig. 7. Cutting the Teeth of a Small Helical Gear in a Thread Milling Machine*

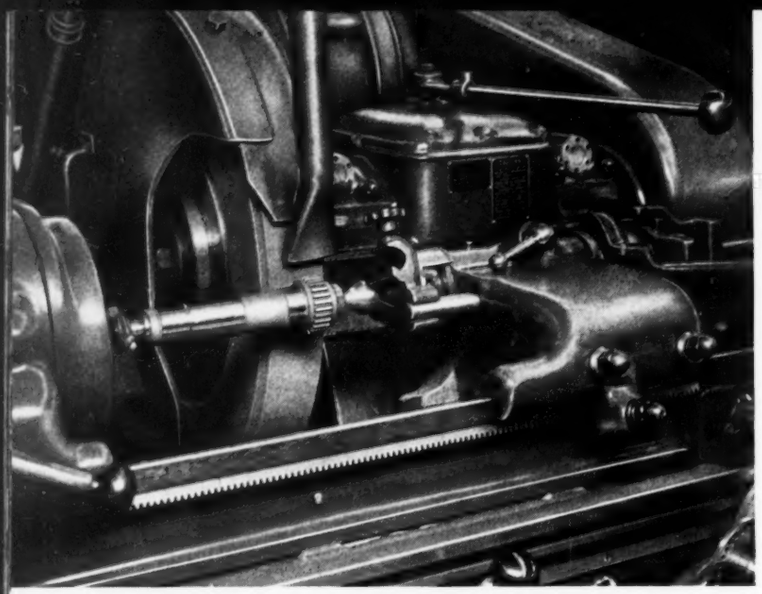




*Fig. 8. All Spur Gears are Ground on the Outside Diameter as well as on the Teeth*

0.0005 inch; and in the third grind within 0.0002 inch. The table is reciprocated hydraulically and the work indexed after each return movement. All together about 0.0015 inch of stock is ground off each side of the splines.

At the left in Fig. 9 is seen a set-up stand on which each impeller gear sleeve is placed prior to this operation for attaching the driving dog in the correct relation to the previously milled or hobbed splines. The part is mounted between centers on this stand and placed in the correct radial position by bringing two gaging points into contact with diametrically opposite splines. The driving dog is then attached to the work with an extension of the dog located between studs on an arm of the fixture. When the work is placed in the machine, the set-up is accurate within about 0.001 inch.

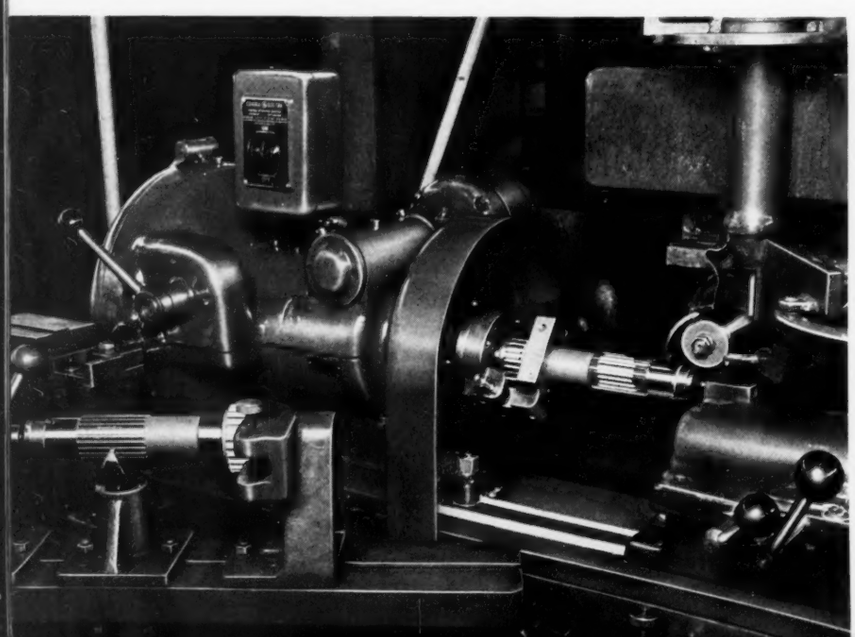
Fellows gear lapping machines of the type shown in Fig. 11 are employed for spur gears. In this operation, an internal cast-iron lap is driven by the work, and at the same time, the gear is reciprocated about 1/4 inch, so as to distribute the abrasive compound adequately over the teeth of the gear and the lap. The practice is to run each gear in the forward direction for about two minutes and then in the reverse direction the same length of time. The operating speed is approximately 125 surface feet a minute.

The inspection of a large bevel reduction gear and pinion on a Gleason gear checker is shown in Fig. 12. In this inspection, the gear and pinion teeth are coated with red lead or Prussian blue, and as they are run in mesh, a load is placed on the pinion by the operation of a lever on the tail-



*Fig. 9. Grinding Square Splines on the Impeller Gear Sleeve, This Operation being Performed before the Gear Teeth are Ground*

*Fig. 10. Gears up to 1 1/4 Inches in Face Width are Ground on a Hydraulically Actuated Machine with Two 20-inch Wheels*



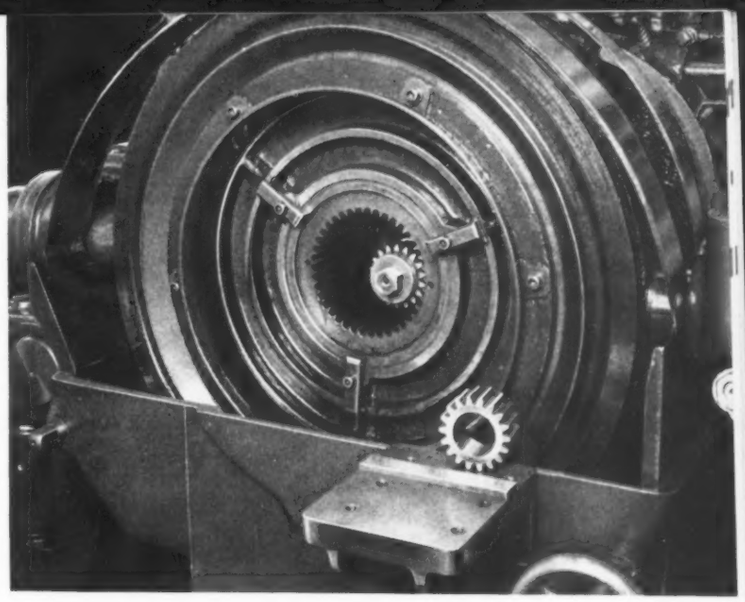


*Fig. 11. The Last Operation on Spur Gear Teeth Consists of Lapping in the Machine Shown*

stock. In this way, an indication is obtained of the bearing of the various teeth on each other. There must be at least 95 per cent full contact of the gear teeth for a set of gears to pass this inspection.

A typical inspection with a Michigan gear tester is shown in Fig. 13. This machine has a sine bar which acts as a compensator for differences between the lengths of arc on a friction disk which originates the machine movements on the base circle of the gear being checked. The friction disk is integral with the work-holding spindle and imparts movement to the sine-bar carriage. Angular settings of the sine bar control the movement of the indicator head, the latter being counterweighted to hold it against the sine bar. Each degree of work rotation is read on a scale that extends along one side of the sine-bar carriage. Two indicators give a reading of tooth form on the front and back faces of a tooth in the same set-up.

As in the case of other airplane engine parts, each gear forging is marked with a number when it arrives at the Pratt & Whitney plant that indicates the melt and ingot stock from which it was produced. Records of each ingot are kept in the steel mill and forge shop. Whenever this lot number is machined off the gear forgings, it is immediately restamped, and after a gear has been hardened, another number is added by the Pratt & Whitney heat-treating department that indicates the particular heat-treating process to which the gear has been subjected. Thus, at any time before or after a gear has been placed in service it is possible to trace the gear back through its heat-treatment and complete manufacture.



*Fig. 12. Bevel Gears are Coated with Red Lead or Prussian Blue and then Run together to Determine the Degree of Tooth Bearing*

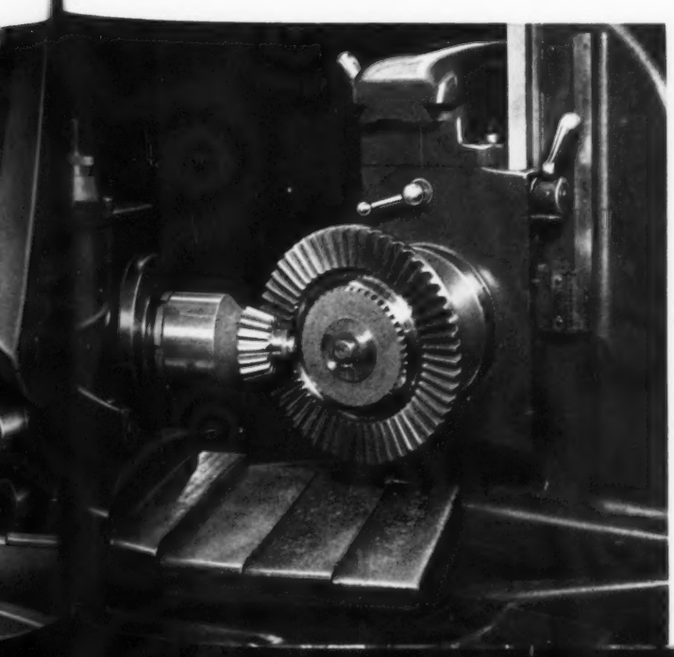


*Fig. 13. Gear Testing Equipment which is Employed for Accurately Checking the Involute Curve of Spur and Helical Teeth*

# *Airplane Landing Gear Parts*

THE close accuracy and high degree of finish to which parts must be machined in the manufacture of aircraft engines and propeller units is well known, but the average engineer thinks of the production methods used in industrial plants for fabricating the planes in terms of riveting, welding, and sheet-metal forming. That precision machining is also performed in plants of this classification, however, will be apparent from the illustrations in this article, which show typical operations in the machine shop of the Curtiss-Wright Aeroplane Division, Curtiss-Wright Corporation, Buffalo, N. Y.

The regular products of this shop include the landing gear for airplanes, on the cylinders and pistons of which limits as close as plus or minus 0.005 inch must be maintained. Landing gear cylinders are received in the form of solid forgings, as shown by the example seen lying on the ways of the cross-slide carriage of the machine illustrated in Fig. 1. These forgings weigh 120 pounds when they reach the plant, and only 24 pounds when finished, a reduction in weight of 80 per cent being effected.

The solid cylinder forgings are drilled the full length by means of an oil drill, 2 11/16 inches in diameter, having a fluted length of 28 inches. The forging is then rough-machined all over in a turret lathe, after which it is heat-treated to a hardness of 38 to 41 Rockwell C. It is then brought to the Gisholt heavy-duty turret lathe shown in Fig. 1, for finish turning and boring, an operation in which 0.020 inch of stock is left on the diameter of both internal and external surfaces to be removed later by grinding.

In the turret lathe operation shown, the first cut is taken by a short two-bladed boring-bar on the turret, which starts a hole in the end of the cylinder, the work being supported by the headstock of the machine and a steadyrest which engages a short surface previously turned. The turret then indexes, bringing a long two-bladed boring-bar into line with the work for boring a hole 3 1/16 inches in diameter to a depth of 23 7/16 inches, in the case of the particular cylinder being machined. At the end of this cut, the first long reamer seen on the turret is indexed into place for reaming the hole to its full depth, and then the other reamer takes a second cut on the hole.

The fifth turret tool bores a thread surface, this tool being mounted on a turret-slide so that it can be adjusted at the end of the boring cut for chamfering the end of the hole. While these cuts are being taken, the outside of the cylinder is com-



***Fig. 1. In Roughing and Finishing Landing Gear Cylinders, in Two Turret Lathe Operations, 80 Per Cent of the Stock is Cut Away***

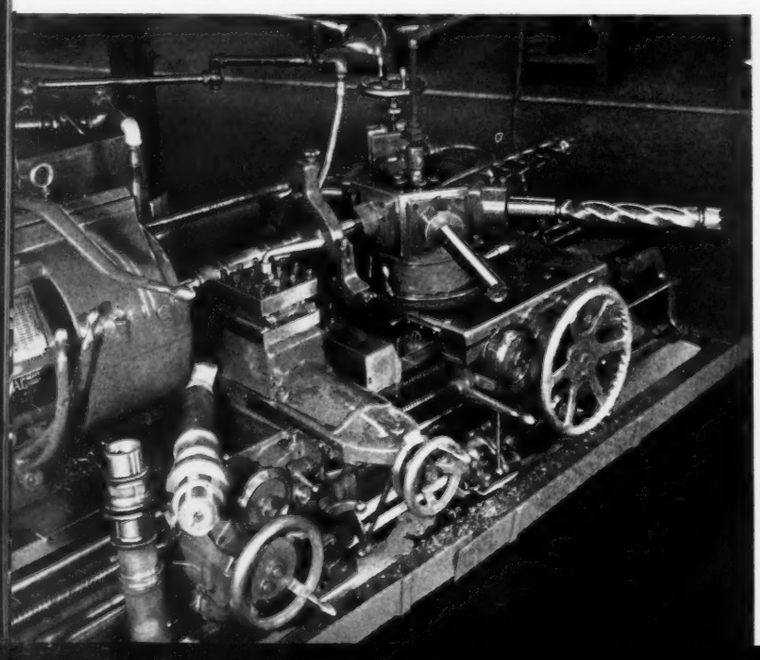
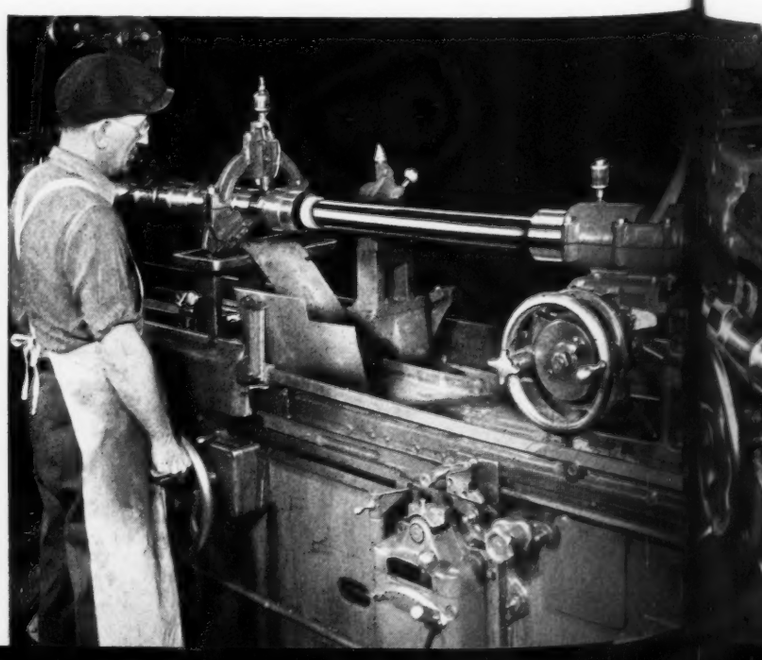


***Fig. 2. Grinding the Bore of a Cylinder for Aircraft Landing Gears, an Operation in which the Diameter Limits are Plus 0.002 Inch Minus Nothing***



# *Require Precision Machining*

pletely turned by tools on the front toolpost, except for the surface supported in the steadyrest. The pistons for landing gears are turned and bored in a similar manner on the same type of machine.

After a straddle-milling operation on the cylinder lugs, the cylinders are ground internally in the machine shown in Fig. 2. In the operation illustrated a cylinder is being ground to a diameter of 3.062 inches within plus 0.002 inch minus nothing, stock to a depth of 0.003 inch being left all around the internal surface for removal by honing. Landing gear pistons are ground on this machine to three different diameters within limits as close as plus 0.001 inch minus nothing.

Both cylinders and pistons are ground externally in the Norton cylindrical grinding machine shown in Fig. 3. The piston shown between the centers of the machine is ground to a diameter of 2.872 inches for a length of 27 inches within diameter limits of plus 0.0005 inch minus nothing. Roundness and straightness must also be held within 0.0005 inch. The cylinder seen at the front of the table has several sections that are ground in plunge cuts within limits of plus 0.0005 inch minus nothing. For the plunge cuts, the grinding wheel is trued to finish fillets where the cylindrical surfaces join shoulders or flanges.

The lugs or ears at one end of the cylinders and pistons are straddle-ground in the Thompson hydraulically operated surface grinder shown in Fig. 4, which is equipped with two grinding heads. Here two pistons are seen mounted end for end on the machine table, the lugs being located radially by keys on a fixture which are inserted between the previously milled inner surfaces of the lugs. This set-up is of the utmost importance, because the outer faces of the lugs after the grinding operation must be the required distance from the center line of the piston within 0.002 inch. The ground width across the lugs must be 2.249 inches within plus 0.001 inch minus nothing. Obviously, the milling operation on the inside of the lugs must also be performed with extreme accuracy.

In front of the pistons in Fig. 4 are seen other examples of work ground on this machine. Near the left end of the table is a landing gear truck, the flat sides of which must be ground to the same width as the piston lugs and within the same tolerance. The scissors link near the right-hand end of the table is straddle-ground on both the inside and outside surfaces of the yoke bosses, and also on both sides of the opposite end. The limits on this part are plus 0.001 inch minus nothing.

The honing of landing gear cylinders is per-



***Fig. 3. Pistons for Airplane Landing Gears are Ground Externally within a Diameter Limit of Plus 0.0005 Inch Minus Nothing***

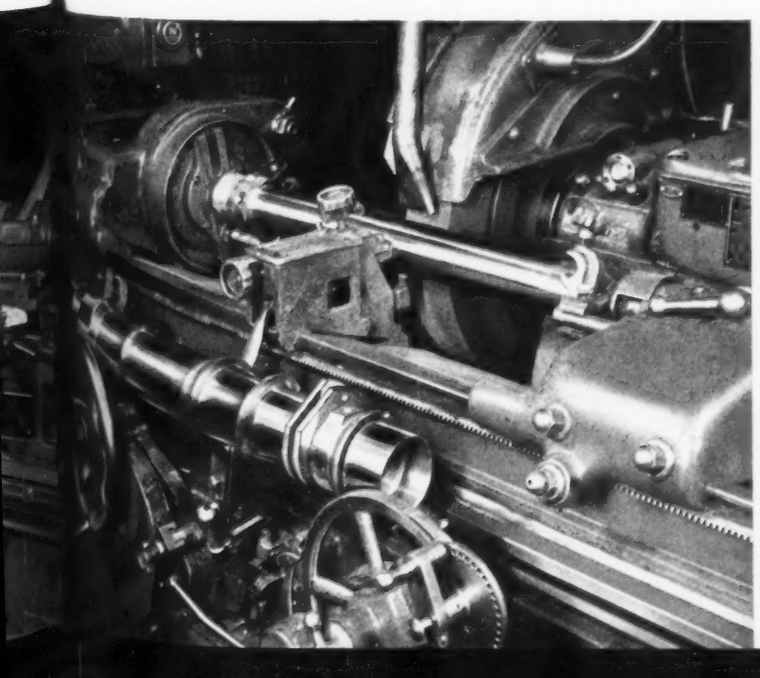
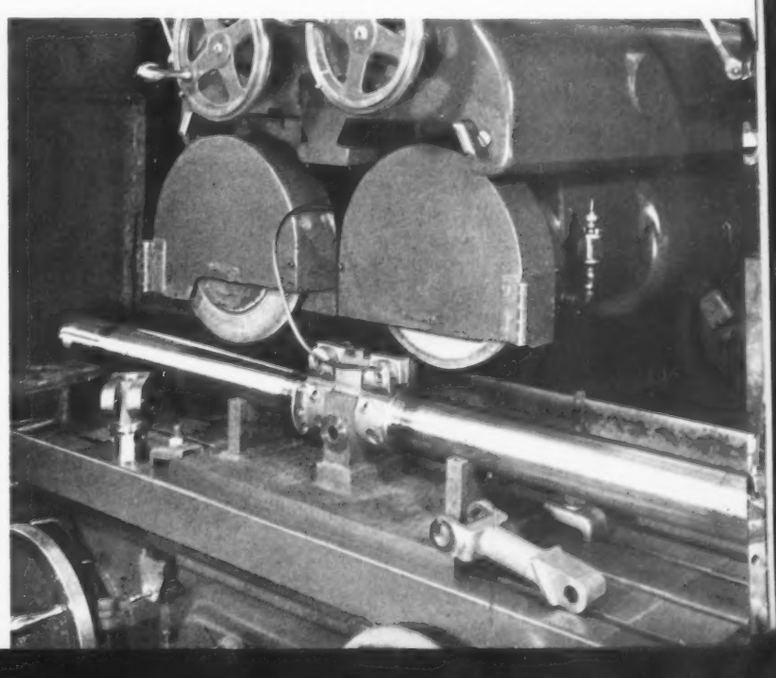


***Fig. 4. Surface Grinding Machine Equipped with Two Wheels for Straddle-Grinding Surfaces on Landing Gear Parts to Extremely Close Limits***



formed in a Barnes hydraulically actuated machine. The 21-inch long cylinders are honed to a diameter of 3.750 inches within plus 0.002 inch minus nothing, and the 24-inch long cylinders, to a diameter of 3.065 inches within the same limits. The cylinders are honed to a smoothness of about 10 micro-inches. Mineral seal oil, mixed with No. 155 International honing compound, is used as a coolant. The honing spindle runs at 208 R.P.M. and reciprocates at the rate of 3 1/2 complete cycles per minute. The practice is to rough-hone the cylinder bores to within 0.001 inch of the required diameter and then finish-hone. Micromatic hones are used.

Eight holes are broached through the piston walls, as indicated by the piston standing on the bed of the American broaching machine in Fig. 5. This operation on the pistons is performed in a similar manner to the one illustrated, which consists of broaching four holes through a landing gear truck. Holes are drilled through the part in the desired position preliminary to the broaching operation, and these holes are shaped to square openings as the broach is pulled through them, two holes being, of course, broached simultaneously. In the case of the truck, the holes must be 0.814 inch square within limits of plus 0.001 inch minus nothing. The distance from the top of the holes to the end of the piece must be held within plus 0.002 inch minus nothing.

In the truck broaching operation, the work-piece is located radially from the surfaces ground in the Thompson grinding machine. The fixture is made with two wings that extend outward at angles of 45 degrees, and the part is located first with one ground surface against one wing for broaching two holes, and then with the second ground surface against the other wing for broaching the remaining two holes. A plug with holes that provide clearance for the broach is inserted vertically in the landing gear truck, as shown, so as to provide adequate support for the thin wall of the part during the operation. The work-piece is located for height by a shelf on the fixture.

The right-hand end of the broach is supported on a carriage, from which it is automatically disconnected to allow the broach to be drawn through the work. On top of the fixture housing is seen one of the broached landing gear trucks and also a motor mount bracket in which a hole is similarly machined. Four settings of the piston are required, of course, to broach the eight holes.

Metering pins, such as seen in the foreground in Fig. 6, must be machined to an irregularly changing contour, the diameters of which are held to specified dimensions within plus or minus 0.0005 inch. In the case of the metering pin shown between the centers of the Monarch lathe illustrated, there are four different straight diameters connected by tapered sections. The diameters range



*Fig. 5. Broaching Equipment Employed for Cutting Square Openings within Close Tolerances in Several Landing Gear Parts*

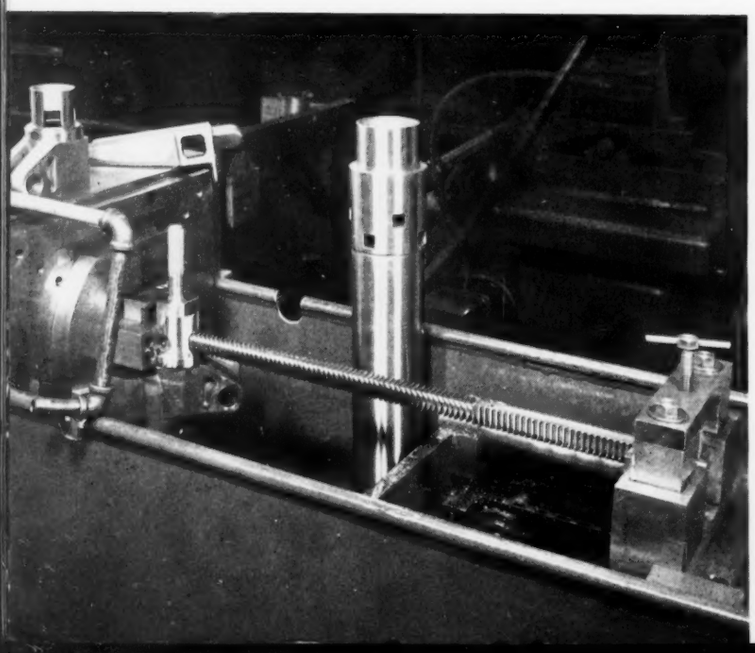
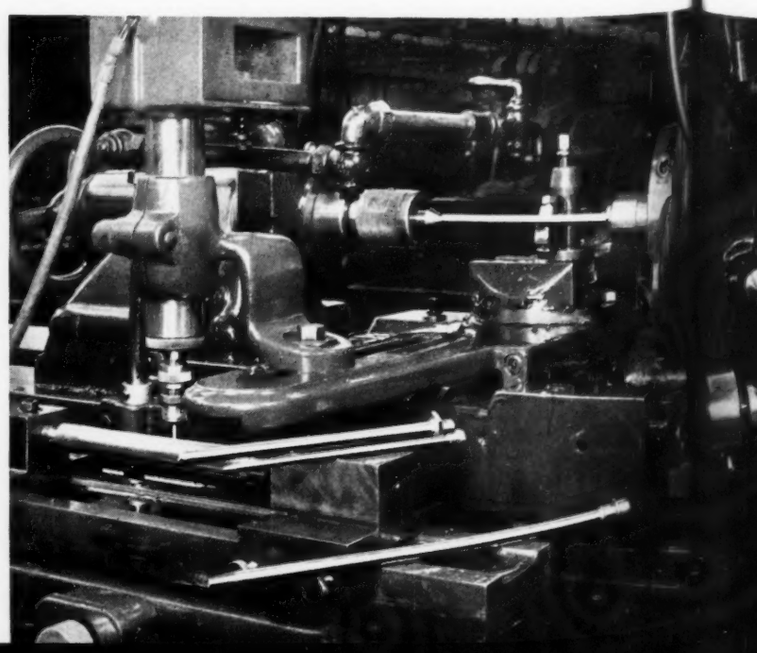


*Fig. 6. Machining the Irregular Contours of Metering Pins on a Monarch Lathe Equipped with a Keller Attachment*



between 0.383 and 0.490 inch, the over-all length of the metering pin being 7 1/2 inches.

The desired contour of the metering pins is obtained by means of the Keller attachment at the rear of the machine, a tracer following along a master made to the same contour. The in-and-out movements of the tracer as it follows the master are imparted by electrical means to the tool-slide, so that the tool moves in and out in similar fashion. Roughing and finishing cuts are taken, after which the metering pin is polished in the same lathe.

Fig. 7 shows a thread being milled on one of the shaft extensions on a landing gear trunnion in a Lees-Bradner machine. Previous to this operation, the steel forging has been machined and heat-treated to about 39 Rockwell C., at which hardness the material has a tensile strength of approximately 150,000 pounds per square inch. The thread is produced in one revolution of the work by a multiple-thread cutter, which is considerably longer than necessary, so that it can be used on other work-pieces without changing the cutter set-up.

The thread, which is 1 1/8 inches in diameter, 18 threads per inch, and of National Form, Class 3 fit, is produced in a roughing and finishing cut, the two cuts being performed in 13 minutes. A similar thread is milled on the opposite end of the trunnion. The right-hand or tailstock center does not revolve with the work, and is flat on the side toward the cutter.

The operation shown in Fig. 8 consists of milling an Acme thread 3/4 inch in diameter, 10 threads per inch, for a length of 5 1/2 inches on air-scoop operating screws. This thread, also, is cut after the screw has been heat-treated; in this case the hardness is from 25 to 29 Rockwell C. Limits of plus nothing minus 0.002 inch are specified on the pitch diameter of 0.698 inch. Owing to the toughness of the material and the fact that both roughing and finishing cuts are taken, the total time required to produce this thread is slightly over 2 hours. However, much more time was formerly consumed in chasing the thread in a lathe with a single-point tool, and difficulty was experienced in cutting the thread within the specified tolerance. A follow-rest supports the work.

The machine shop of an airplane plant is called upon to make a great variety of pieces of special shapes for experimental purposes—shapes that will afterward be produced by forging if the part is finally adopted. Generally, the machining of these special shapes calls for the routing out of large amounts of stock, as indicated by the examples seen on the vertical milling machine in Fig. 9. The long ribbed piece on the table was milled from a bar of rolled Duralumin such as shown at the left of the piece. At the right of these pieces and in the vise at the left are additional parts produced by milling. On some parts, as much as 85 per cent of the stock is cut away.



*Fig. 7. Equipment Used for Milling a Thread on Both Ends of Landing Gear Trunnions*

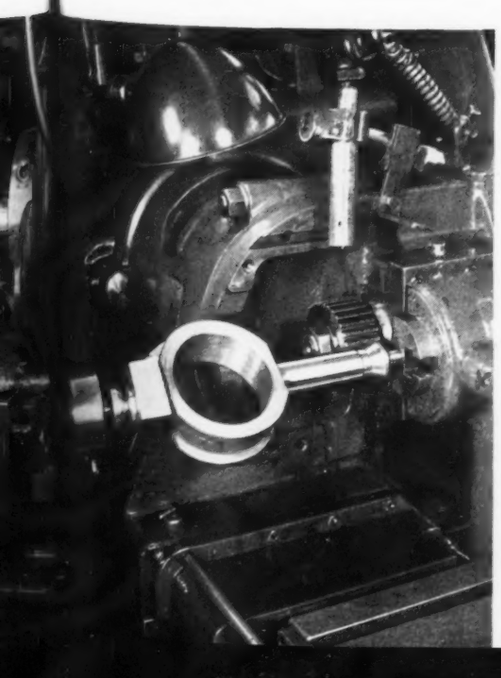


*Fig. 8. Milling a Thread on a Long Air-scoop Operating Screw after the Part has been Heat-treated*

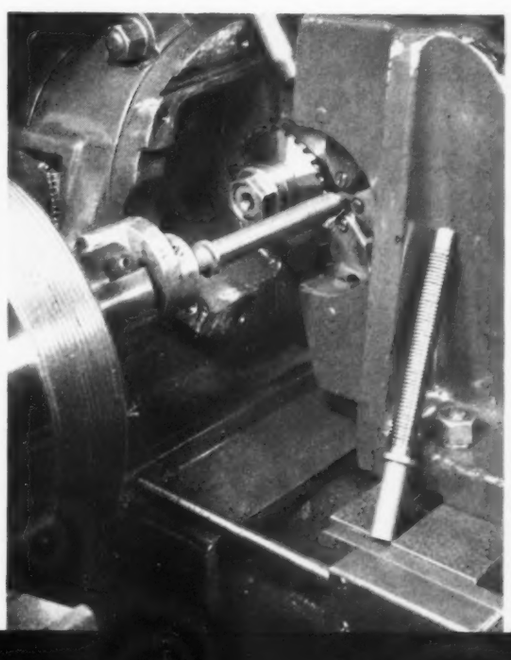
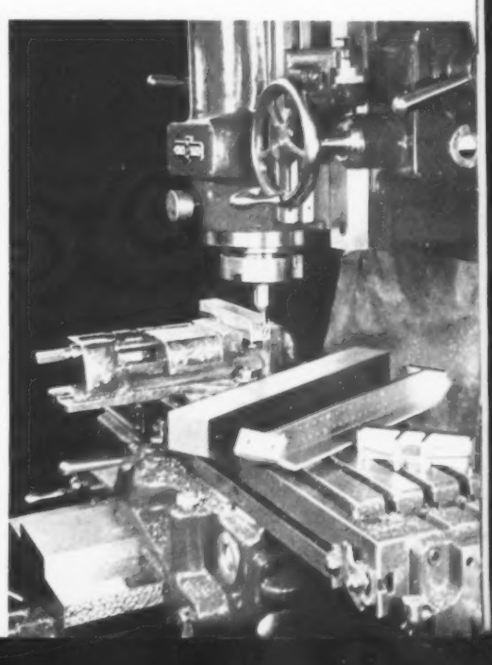
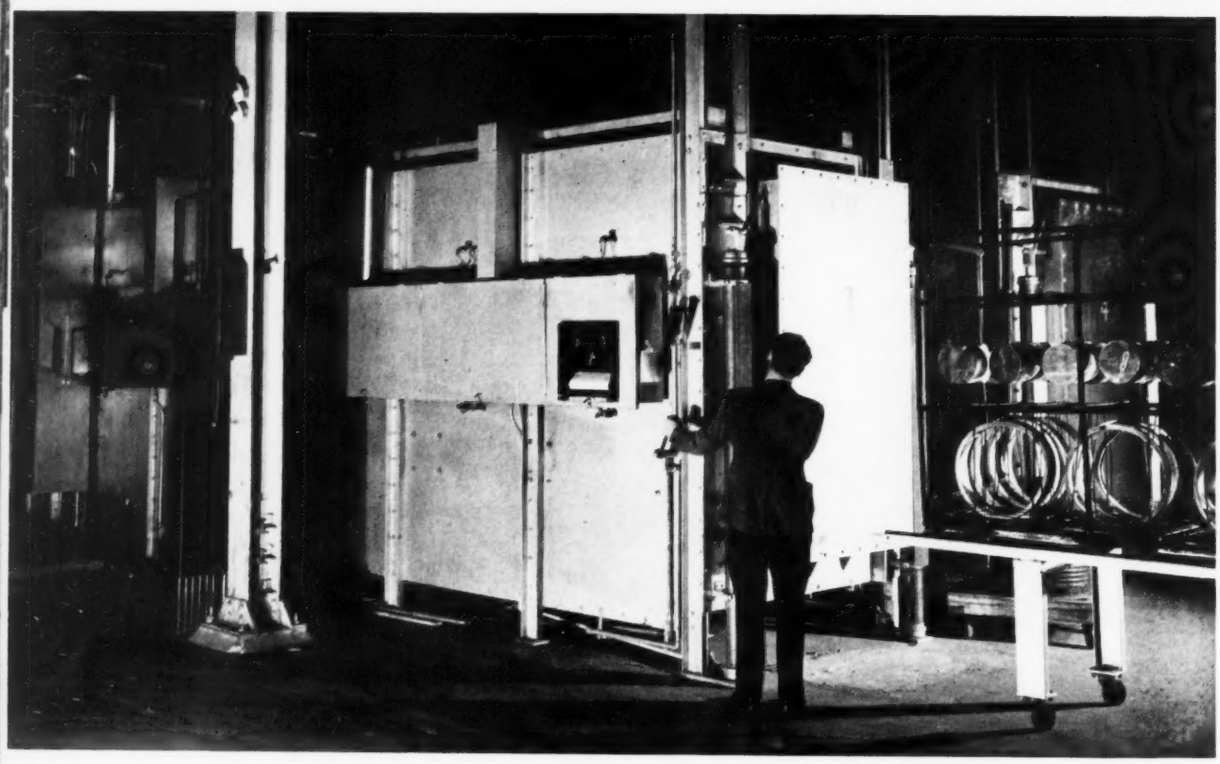


*Fig. 9. Producing Special Shapes from Bar Duralumin for Experimental Purposes*



# *Heat-Treating Aluminum Alloys*



*By L. N. DAVIS, Plant Engineer and*
*J. R. GOLDSTEIN, Development Engineer*
*Douglas Aircraft Co., Inc., Santa Monica, Calif.*

THE widespread adoption of the hydraulic press method of forming aluminum-alloy aircraft parts by the use of one die in combination with pliable rubber has necessitated a change in the methods of heat-treating the high-strength aluminum alloys used. In theory, the heat-treatment of aluminum alloys is a rather simple matter. The process is divided into two steps, the solution and precipitation treatments.

In the first step, the aluminum alloy is soaked at a temperature of about 900 degrees F., the exact heat depending upon the particular alloy being treated. This soaking serves to place all of the compound $CuAl_2$ (the strength-giving ingredient of the more common heat-treatable aluminum alloys) into solid solution with the aluminum base metal. A rapid quench then stabilizes the solid solution at room temperature.

The second step, precipitation of a definite amount of this compound $CuAl_2$, increases the strength and hardness. The more common high-strength alloys automatically precipitate out the correct amount of $CuAl_2$ when allowed to age at room temperature, the action being completed with no further attention on the part of the fabricators. Other alloys must be heated to about 300 degrees F. to accomplish this precipitation.

Since the bulk of the material used in aircraft construction in this country requires no artificial aging, only the methods for the accomplishment of the solution heat-treatment will be discussed here.

In the solution heat-treatment, accurate temperature control is necessary. Likewise, the quenching operation that follows the soaking at high temperature requires careful control. Any delay in lowering the temperature of the alloy from that at which it was soaked to room temperature will not only affect the physical properties but will also decrease the resistance of the material to corrosion, particularly of the intergranular type. The

# *for Douglas Aircraft*

Alclad type of alloy, in which the basic material is coated by means of a rolling process with a 5 per cent thickness of pure aluminum on each side, presents a further limitation to the soaking process. It is necessary that the material be held at the proper temperature for a sufficient time to force all the alloying ingredients into solid solution. Too long a soaking of Alclad parts results in a migration of some of the alloying constituents into the pure aluminum coating, thus destroying the corrosion resisting property of the coating.

These requirements do not necessitate any deviation from the method that has been used by the aircraft industry for a number of years, that is, heating the material in a bath of fused sodium nitrate for the proper length of time and then quenching in a tank of cold water. This method is satisfactory for certain types of work; these types, however, are steadily decreasing in number with the increased use of the hydraulic press method of forming with a die and rubber.

In the hydraulic press forming method, annealed aluminum-alloy sheets are generally used. When the forming has been completed, it is necessary to heat-treat the part. Experience has shown that if a large part formed from thin stock is plunged into a bath of fused sodium nitrate or its equivalent at the solution heat-treatment temperature, the part will warp badly, because of the uneven distribution of heat resulting from the inability of the operator to submerge all surfaces of the part simultaneously. The same thing occurs when the part is removed and immersed in the quenching water. As a result, the fully heat-treated part, although not aged, is badly warped.

Fortunately, before aging takes place, the material is still soft enough to be straightened, and it can be kept soft enough by holding the temperature below the freezing point of water until the part is ready to be returned to its normal shape. Obviously, such a method of straightening the pieces individually is out of the question in quantity production. Incidentally, this straightening of warped pieces cannot be accomplished under the hydraulic press with the original die, because the spring-back in the heat-treated material, even though not aged, is greater than when the part was formed in the annealed condition.

In order to make the hydraulic press method of forming practical for quantity production, the Douglas Aircraft Co. found it desirable to provide some means for heat-treating the work without distortion. A new technique was developed, which involves the use of an electric air furnace for soaking and water fog for the quenching medium. Two units were designed to work together, in order to provide maximum productive capacity and reduce to a minimum the time required for handling between the soaking and quenching operations. The general arrangement of the units, as now in operation, may be seen in the heading illustration. The furnace in the foreground is equipped with pneumatic doors at the front and back. From this furnace, the work is discharged through a quick sliding door into the quench tank in the left background which is provided with a "vault" beneath the floor for circulation of the water fog.

This furnace was particularly designed for accurate control within a much narrower temperature range than the plus or minus 10 degrees variation allowable in the solution heat treatment of the modern high-strength aluminum alloys. Every part of the furnace is held within the desired tem-

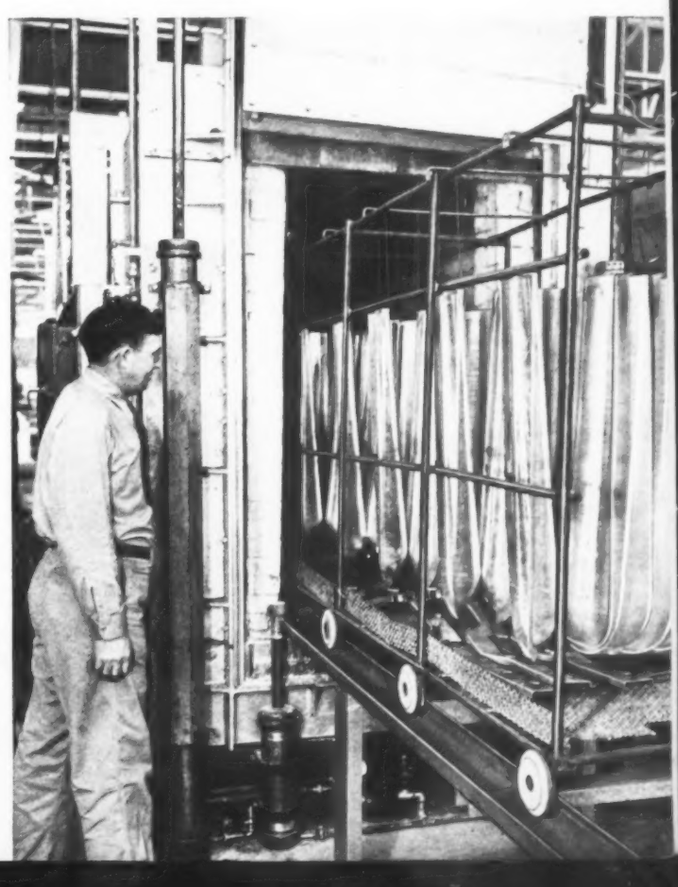


*Fig. 1. Loading an Electric Air Furnace Designed for Heat-treating Aluminum-alloy Sheet-metal Parts*

perature range, because of provisions for supplying heat locally to compensate for temperature deficiencies in any locality of the furnace.

This close control of temperature has been accomplished by providing twelve thermo-couples for a similar number of individual heating units. These heating units are placed behind the ceramic baffles seen in Fig. 2 to prevent direct radiation of the heat to the parts being treated. This provision was found necessary because, with a dense charge, such as shown in Fig. 1, serious overheating of the parts on the outside of the rack would occur if direct radiation were permitted. Blower outlet tubes between the charge and the baffle prevent over-running of the control on the high temperature side.

Air is fed into the blower from the coolest part of the furnace. A solenoid valve which operates the outlet nearest to the heating unit that it is tied in with is energized to permit discharge of the somewhat cooler air when the heating unit is turned off at the temperature indicated by the corresponding thermo-couple. The blower pipe outlets are equipped with flat nozzles designed to spread a thin layer of air over a large area of the baffle plates. This arrangement prevents any further increase in temperature of the charge in that locality after the heater has been turned off. The blower system provides a general circulation of air.

The charge of work is supported on a rack designed in such a way as to allow the maximum load to enter the work chamber and be withdrawn in a minimum amount of time. The racks are made of a light alloy steel tubing, as seen in Fig. 1, and with the least possible amount of material, so as to minimize heat storage.

The furnace is equipped with a recording pyrometer, and is so wired through a timer that each of the twelve sections is individually controlled. When the solenoid valves are electrically disconnected and set for constant circulation of air, the maximum variation of the furnace temperature from the standard is only 3 degrees F. Connecting the solenoid valves results in a decrease in this range of variation.

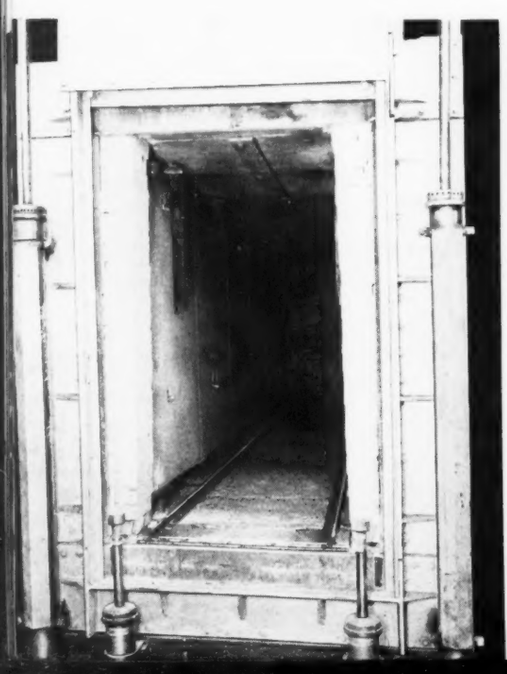
The quench chamber is provided with both pressure (on the top) and suction (on the bottom) forced draft. Into this uniform air blast a fine mist of cold water is sprayed by a multiplicity of high-pressure water jets. Some of the 272 jets in the quench chamber may be seen in Fig. 3, each jet being operated at a water pressure of 250 pounds per square inch. The combination of the high-velocity air and the spray of water results in a quench that is both even enough in its action on each part to keep warpage to a minimum and rapid enough to meet the exacting specifications under which airplanes are built for the air services of the United States Government.

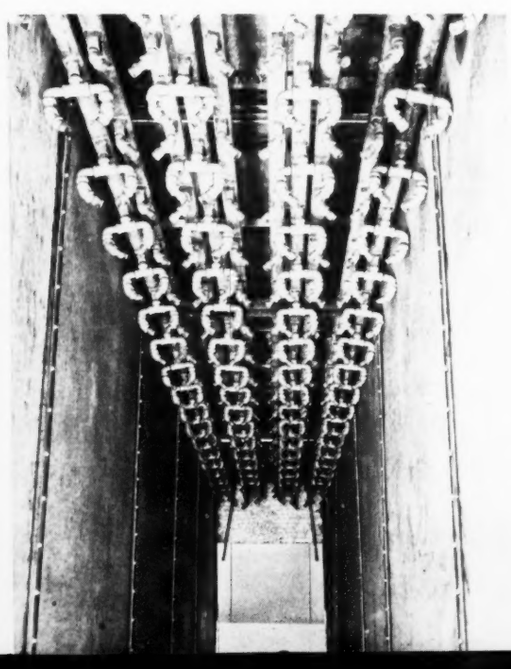
The electric furnace method of heat-treatment possesses another advantage in that the heat-treated parts are free from any salts that might cause corrosion difficulties in service. Another advantage is that parts which have been treated in the electric air furnace and quenched by fog can be spot-welded with a minimum of surface treatment.

*Fig. 2. Interior of Furnace Showing Thermo-couples, Cool Air Tubes, and Baffles*

*Fig. 3. Roof of Quench Chamber, Showing Some of the 272 Water Spray Nozzles*

*Fig. 4. Bottom of Quench Chamber, Showing Exhaust Openings to Vault Below*





# Air Corps Ready for Army Expansion Program

*(Continued from page 767)*

advance action, in order to make the expansion program prompt and forceful.

Contracts, the award of which was made by the Assistant Secretary of War shortly after the signing of the bill by the President, cover the following Air Corps types: Four-engine bomber; pursuit, single-engine plane; pursuit interceptor; attack bomber; and photographic plane.

The success of the four-engine bombardment airplanes operated by the U. S. Army Air Corps during the last two years is well known. Their performance characteristics, when first designed, were the surprise of the aeronautical world. They fly at speeds in excess of 250 miles per hour, carry five machine guns, a crew of six to nine, including a commanding officer, pilot, co-pilot, navigator, engineer, bomber, radio operator, and gunners. All members of the crew can freely exchange stations. This airplane can fly and maintain its altitude, with load, on two engines. This safety factor practically eliminates the possibility of forced landing due to engine failure. Coupled with its long range, it is possible, through radio communication, for this airplane to find a safe landing field, even when fog covers large areas. From the standpoint of maintenance and ruggedness, this plane is an extremely valuable contribution to the military field.

The single-engine pursuit plane, which is exemplified in the Air Corps' P-36A and XP-40 types developed for the Air Corps by the Curtiss-Wright Corporation, will be featured in this first expansion procurement. The XP-40 is supercharged with the built-in blower type of supercharger and is capable of developing an approximate speed of more than 350 miles per hour. This is an internally braced monoplane, of all-metal construction except for the control surfaces, which are fabric covered. The landing gear is of single strut, pneumatic oleo type, retractable into the wing. A constant-speed propeller is provided. This plane is equipped with two machine guns. It is supplied with oxygen to permit operation at extremely high altitudes.

The interceptor pursuit plane is a recently developed type, the purpose of which is to intercept and attack aircraft. One of the models ordered is equipped with twin Allison engines, the other with a single Allison engine. It differs from the normal pursuit type in that the speed at altitude and the rate of climb are greater. Exhaust turbo superchargers are provided, insuring excellent performance characteristics at altitude. A tricycle landing gear improves the landing characteristics of these high-speed planes. Very high speed is a prerequisite of this type.

Much has been published recently about the attack bomber, in view of the competition held by the Materiel Division. The purpose of this type is to attack ground objectives, such as supply depots, railroads, mechanized forces, marching troops, etc. The attack bomber combines the qualifications of the attack and the bombardment types of airplanes, being equipped with bombs as well as machine guns. It is designed for high performance, both at ground levels and at altitude. The three models submitted in the recent design competition were alike in that they possessed twin engines, were all-metal monoplanes, and were equipped with three-bladed constant-speed, full-feathering propellers. The gross weight varied from 8 1/2 to 9 tons. The upper portions of the forward section of the fuselage are made up of transparent panels for maximum crew visibility. The three models submitted by the Stearman, North American, and Glenn L. Martin companies were designed with speedy, large-scale production in view.

An airplane chosen for photographic purposes must be structurally so designed as to make possible the installation of one or more aircraft cameras in favorable positions in the fuselage. The model selected for the purpose is one constructed by the Beechcraft Co. It is an all-metal three-place, two-engine monoplane of low-wing type, equipped with Pratt & Whitney engines developing 350 horsepower each at 7200 feet. It is designed to carry two aircraft cameras in tandem and to develop a speed at 7200 feet of 213 miles per hour.

In undertaking this production, arrangements have been made so that the aircraft industry will not only be able to deliver the designated number of airplanes at the time specified, but will accomplish this task without industrial disruption or interference with the program of civil aviation, with other Government organizations, or with our foreign markets.

With the accomplishment of the broader program—that is, with the expenditure of the allotted $300,000,000—factors other than the aircraft itself will enter in, for an Air Corps is made up not only of airplanes, but of personnel, air bases, materiel of all kinds, armament, equipment, engines, structures for the shelter of personnel, etc. Immediate steps are to be taken in order that these provisions may coincide with aircraft production, insuring effective operation of all aircraft forces in a unified flow of power all along the line.

* * *

The Farrel-Birmingham Co., Inc., Ansonia, Conn., held its third annual service banquet on June 6, with 130 men who had been with the company for over twenty-five years as guests of honor. Edwin Van Riper received a diamond-studded watch charm in recognition of his completion of sixty years of service. A 50-year watch was presented to James Dunn. John Walter received a 25-year service pin. Nine of the employes have been with the company continuously for fifty years or longer.

# New Method of Machining

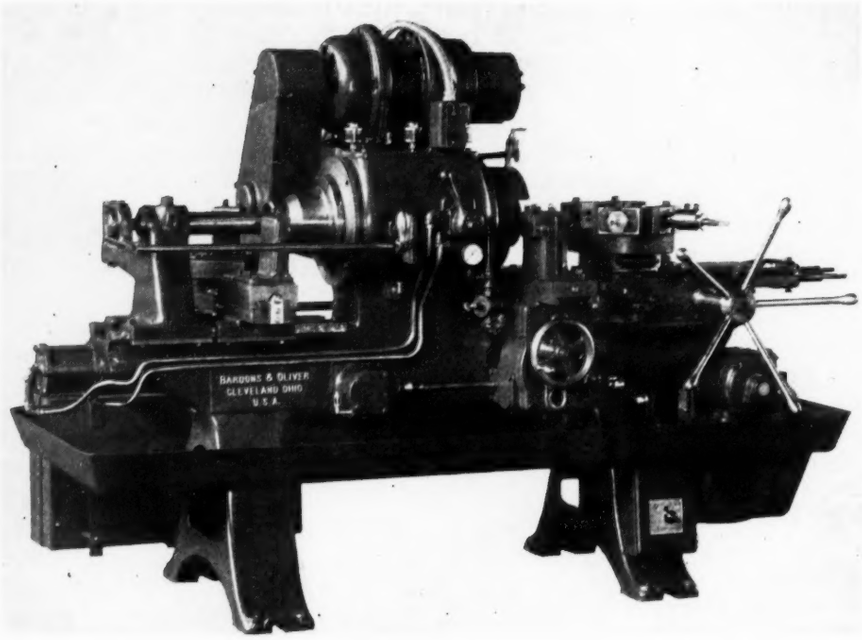



*Fig. 1. Double-end Lathe Equipped with Tool-blocks for Automatically Performing Chamfering and Facing Operations on the Ends of a Cartridge Case while the Hand-operated Turret Drills, Counterbores, and Taps the Primer Hole*

CARTRIDGE cases of the type shown by the cross-sectional view in Fig. 2 are now being machined in double-end machines, with a considerable saving in time. This view shows the general shape of a cartridge case, and together with the accompanying tool diagram, indicates the machining operations performed. The cases are made of deep drawn brass in a large variety of diameters and lengths, the closed or right-hand end having a narrow flange, as shown.

The machining operations include facing the end and forming the flange, as well as part of the outside diameter adjacent to the flange. The open or left-hand end is faced to length and chamfered on the inside edge. In the center of the closed end of the case is a hole known as the primer hole. In some instances, it is only necessary to drill, taperream, and counterbore the primer hole, while in other cases, the hole must be drilled, counterbored, and tapped. On the inside of the closed end is a small face which may or may not require machining, depending upon the design of the cartridge case.

### *Features of Special Machine and Its Tool Equipment*

A new type of turret lathe for machining these cartridge cases has been developed by Bardons & Oliver, Inc., Cleveland, Ohio, as shown in Fig. 1. The work to be machined extends beyond each end of the spindle or work-holding device, and suitable tool-holders and slides are provided at each end.

These machines are designed along the lines of a turret lathe. A conventional hand-feed turret-slide and saddle unit equipped with a special turret carry the necessary tools for machining the primer hole.

Power is transmitted to the spindle through a gear train from a motor mounted on top of the headstock. The tools for the two ends are held in tool-blocks mounted on slides at each end of the headstock. Two of the six turret faces are completely omitted, leaving a large recess through the turret. This recess, when indexed in line with the spindle, facilitates the loading of the cases, which are held in the spindle by means of an air-operated drawback type of collet. The collet is so designed that the gripping force is constant, regardless of the dimensions of the case within its given limitations. The collet is operated by an air control lever at the front of the machine. The inside of the closed end of the case is located by the end of a stop-bar which projects through the spindle and is supported at the left end of the machine by a bracket. This arrangement provides a positive stop when loading. To make the job of loading and unloading easier and quicker for the operator, a brake is incorporated in the drive, which is applied automatically to stop the spindle when the motor current is interrupted.

### *Automatic Control of Machining Operations*

The movements of the three tool-blocks are synchronized, so that either hand or power movement

# Cartridge Cases

## Double-End Machines Known as Cartridge Case Lathes Save Time in Producing Cartridge Cases

of the facing and forming slide *A*, Fig. 2, imparts movement to the two slides *B* and *C*. The hand feed is needed only in making set-ups and adjustments. Power feed to the tool-blocks and their respective slides comes from a shaft driven through a gear train from the main transmission.

Engagement of the power feed starts an automatic feeding cycle. After a rapid approach of the tools to the work, the first machining operation consists of facing the closed end by a feeding movement of tool-block *A*. Toward the end of this motion, the feeding rate drops materially and the necessary forming is done. While the facing and forming operations are being performed on the closed end, the facing tool in block *B* and the trimming and inside chamfering tool in block *C* are moving in toward the work, block *B* being fed in at an angle of 90 degrees to the axis of the machine spindle, while block *C* is fed in at an angle of 45 degrees.

On the return stroke of the tools, a final cut is taken on the front face. After the tools clear the work, there is a rapid motion to give further clearance and also an automatic disengagement of the power feed. To perform all the facing and forming operations, the operator need only engage the power-feed lever.

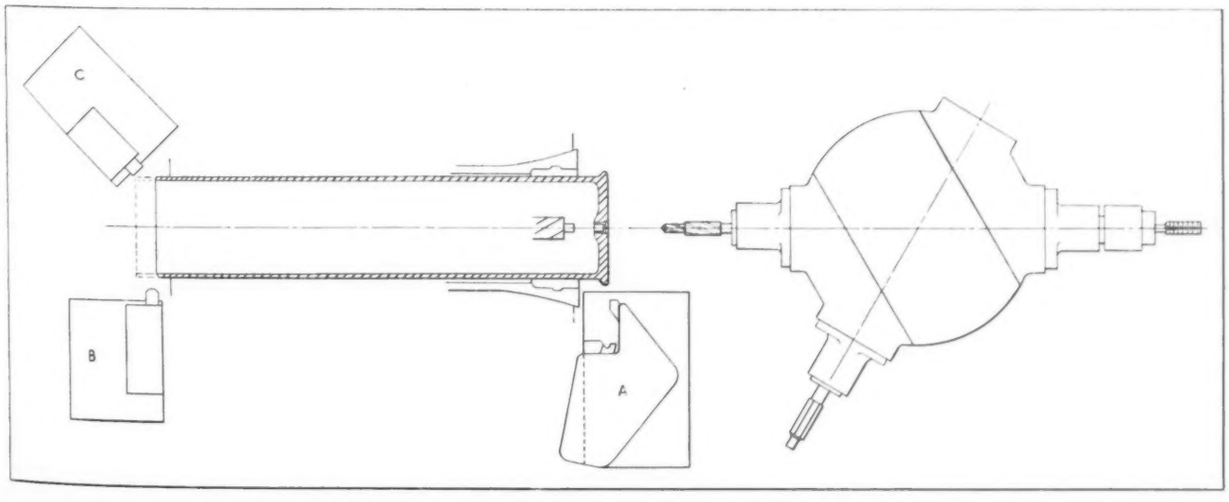
While all of this is being done automatically, the operator performs the necessary hand operations on the hole, which may consist of drilling, reaming, and counterboring, or drilling, counterboring, and tapping. In order to reverse the spindle for tapping, a high-torque reversing motor is used. In those instances where back-facing is required, it is done by a tool such as shown in the tooling diagram, which is held in and moved by a bar that is movable within the stop-bar previously described. Motion is imparted to this bar by means of a lever connected to the head of the machine, together with suitable linkage.

### *Application of Cemented-Carbide Tools*

When the cartridge cases come to this machine, they have a fair amount of metal to be machined off at the open end. If this metal were cut off by the slide *B* with a conventional narrow-faced parting tool, it would leave a ring of metal hanging on the stop-bar. As shown in the tooling diagram, this material is removed by the tool in block *C* which is used for the inside chamfering and moves in at an angle of 45 degrees to the spindle. In this manner, all of the material to be removed is cut into chips and no ring remains.

The work is supported on the outside close to the tools at the open end by a close fitting ring fastened in the rear end of the spindle or by a close fitting extension fastened to the same part of the spindle. This external tubular support is of very rigid design. The tools used for facing and forming are made of cemented carbide, which makes high cutting speeds possible. Three spindle speeds and three feeding cycles are available by means of a gear-shift arrangement, which permits using the most efficient cutting speed and cutting feed when different sizes of cases are to be machined.

*Fig. 2. Diagram Showing Turret and Tools for Drilling, Counterboring, and Tapping the Primer Hole in Cartridge Case While Tools Held in Blocks A, B and C Perform Chamfering and Facing Operations on Both Ends of Case Simultaneously*



# EDITORIAL COMMENT

The precision, necessity for adherence to predetermined standards of quality, and care in the performance of every operation required in the manufacture of aircraft and ordnance materials are not surpassed in any field of large-scale manufacture. Hence, the aircraft plants and the arsenals offer engineering information of a character not equalled elsewhere. The methods of manufacture adopted in these plants may be considered as a standard of guidance in any other industry where accuracy and quality are main requirements.

The July number of MACHINERY, featuring manufacturing methods in aircraft plants and arsenals, therefore, not only gives information on these important branches of mechanical manufacturing practice — information that in the case of an emergency might become of the greatest value—but also describes methods and processes that are applicable in any field where precision, reliability, and high quality are important factors. There is hardly a machining method or process employed in the two important branches of industry featured in this number that is not applicable, with some modifications, in other important branches of the mechanical industry.

## Principles Applied to Precision Work Apply Everywhere

After all, the principles of all machine shop work remain the same wherever performed. The difference is largely in the degree of accuracy required, the volume of production encountered, and the ingenuity with which these fundamental principles are applied. The engineer and production executive engaged in other branches of industry, therefore, is certain to find in the articles published in this number of MACHINERY ideas applicable to the manufacture of his own product. In addition, he has available information that may become highly important to him, should an emergency arise in which all the manufacturing facilities of the nation would have to be called upon to defend what the people of the United States have always cherished as the heritage of an advancing civilization.

For every $100 that the railroads received from the public for the transportation of passengers, freight, express, mail, etc., they paid the tax collectors very nearly $10 in 1938, as compared with $5.33 in 1917, or $6.13 in 1927. For every dollar that the railroads paid in dividends to their owners, they paid 67 cents in taxes in 1917, and $1.94 in 1937. Is it any wonder that the railroads are in a difficult financial position? It is possible to tax other businesses into bankruptcy, the same as the railroads. Government's most dangerous power is its taxing power, because to most men to whom it is delegated, the temptation to abuse that power usually proves too great. It is so easy to spend other people's money.

## How a Business May be Taxed Into Bankruptcy

Every manufacturer who realizes that his tax burden is a danger not only to his own business, but to the men that now find employment and a livelihood in that business, should, if possible, see his senators and congressman, and discuss these facts with them.

The fact that the saving of a few cents in the drafting-room may cost as many dollars in the shop has often been emphasized. A little extra time and care in making clear and explicit drawings will often save costly misunderstandings or mistakes in the shop; but the fact that extra care and time and a slight additional expense in making blueprints will also save a great deal of time and tend to prevent costly mistakes in the shop has perhaps not been emphasized as often.

## Good Blueprints Save Many Times Their Cost in the Shop

Nevertheless, it is obvious that no matter how accurately and carefully the drawing is made, the care and time expended upon it are largely lost if the blueprint is not equally clear and distinct, so that it can be easily read in the shop. Otherwise, much time is wasted in trying to decipher the blueprint, and there is danger of guesswork, which may turn out to be very costly. It cannot be too strongly emphasized that the time and expense involved in making as good blueprints as printing equipment and paper make possible are a very good investment—an investment that pays dividends in the saving of time and materials in the shop.

# Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

## Mechanism for Imparting Oscillating Motion to Adjustable Arm

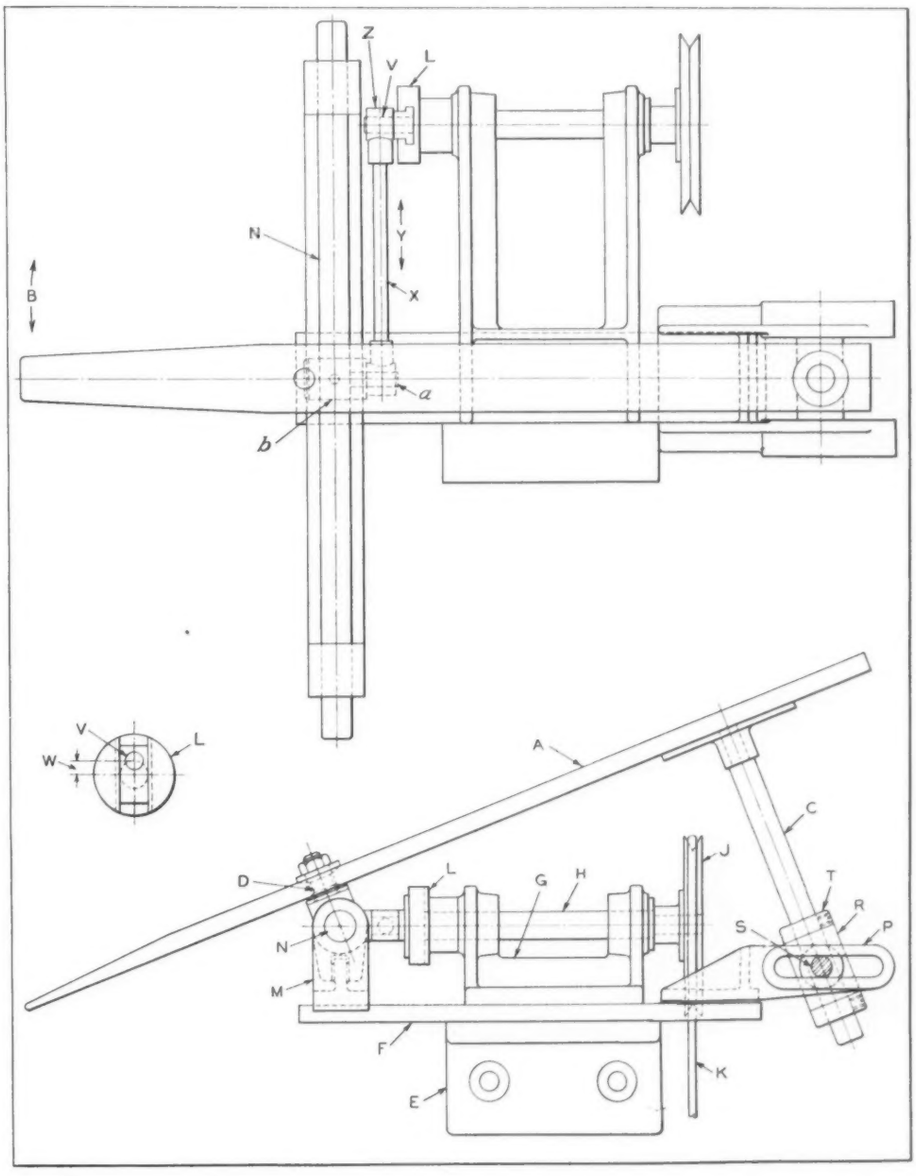
By F. SERVER

The mechanism shown in the accompanying illustration is designed to impart an oscillating or vibrating motion to the arm *A*, which can be adjusted to various angular positions. The mechanism is driven by a round belt *K* from a V-pulley within the machine on which the oscillating motion is employed. The complete mechanism, including arm *A*, is mounted on a baseplate *F*, which is secured to the machine by the bracket *E*.

Arm *A* pivots about the center of rod *C*, the oscillating motion indicated by the arrows at *B* being obtained from the reciprocating motion transmitted to the stud *D* of the cross-head *b*. The necessity for adjusting arm *A* to different angular positions is a factor that makes the design of this mechanism of particular interest. Provision for adjusting the length of the oscillating stroke also lends interest to the design.

The means for obtaining the oscillating motion will be described before considering the adjustment features. The shaft *H*, driven by belt *K*, is provided with a crankpin *V* for the bearing *Z* on one end of the connecting-rod *X*. The bearing at the opposite end of the connecting-rod is fitted on a pin *a* in a sliding block or cross-head *b*, of which stud *D* is a part. The reciprocating motion of stud *D* transmitted by the movement of the connecting-rod *X*, indicated by the arrows at *Y*, produces the required oscillation of arm *A*.

The bracket *M* supports the shaft *N* on which the cross-head *b* reciprocates. There is a slotted arm on the under side of the cross-head which is a sliding fit over the guide rail on the base of bracket *M*.




Mechanism for Oscillating Arm A as Indicated by Arrows B

The guide rail prevents the cross-head from rotating on shaft *N*. The length of the arc through which arm *A* oscillates can be changed to suit requirements by adjusting the sliding block in the flange *L* in which the crankpin *V* is mounted. Adjusting the block to increase the distance *W* of the crankpin *V* from the center of shaft *H* increases the length of the arc through which arm *A* oscillates.

Stud *D* is fastened to arm *A* in such a manner that the arm can be tilted to any desired angle with the horizontal. The block *R* in which rod *C* pivots can be swiveled in bearing *P* and locked in the required angular position by a clamping bolt *S*. The collars *T* are used to locate rod *C* in block *R*.

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## Plate Feeding Mechanism

By JOSEPH WAITKUS

The transfer of thin plates *A*, Fig. 1, from the horizontal magazine to the vertical feeding position indicated at *V*, by means of an automatic mechanical movement, presented a very interesting problem. The mechanism designed for this work may suggest the solution to similar feeding problems. The plates *A* are squares of alloy material. They are highly polished on one side, and require a reasonable amount of care in handling to avoid scratching.

It was found that the best method of handling the material was to raise it vertically from the magazine, turn it into the vertical plane at *E*, and finally move it horizontally to the position indicated at *V*, over the point where it is to be deposited. The grip on the plate is obtained by a vacuum created in small soft rubber cups *C*. Flexible hose connects the cups with a suction apparatus provided with a valve for breaking the vacuum at the moment desired.

The plates are stacked between holders *B*, fastened to the table of the machine. The vacuum cups *C* are fastened to retainers which, in turn, are attached to the equalizing holder *D* by studs. The retainers, with their cups, are free to adjust themselves to the surface of the plate to insure a proper hold on the plate. The vacuum hose is attached to the cups at *G*. Holder *D* is attached to the lever *H* by a stud *J* which is pinned to the holder.

Stud *J* is fitted into the elongated slot in lever *H* and extends beyond the side of holder *D* into the guide groove provided between the projections *L* which are a part of the side plate *M*. Lever *H* is fastened to shaft *N* by set-screws. The short end of this lever is provided with a contact pin *P*.

The lifting bar *Q* has a projection *R* on it which is in position to engage with pin *P*. The vertical movement of the lifting bar is guided by two cam-plates *S* and the holding bars *U*, which are fastened to the side plate *M* by the same screws. This construction retains the lifting bar in place on the face of the cam-plates.

The holes for the screws through plates *S* and bars *U* are large enough to permit accurate adjustment of the cam-plates. Each of the cam feeders fastened to the lifting bar *Q* consists of a pin forced into the bar, with a roller *W* fitted into the cam groove. The lower end of the lifting bar is attached to the actuating mechanism (not shown).

The horizontal pusher-bar *X* is fitted into a milled slot in the outer face of the side plate *M*, and is held in place by plate *Y* and screws *Z*. A pin *F*, forced into bar *X*, serves as a connection to the yoke of the oscillating bar *K*. The lower end of the oscillating bar is connected to a suitable mechanism (not shown) and timed with the operation of the lifting bar *Q*. The opposite end of the pusher-bar *X* is provided with a bore into which the end of shaft *N* is fitted and retained by screw *O*, Fig. 3. Shaft *N* is milled to a square cross-section, as shown by the diagrams Fig. 4. The square has a sliding fit in the horizontal slot machined in the side plate *M*. The purpose of this feature will become obvious when the operation of the entire mechanism is considered.

The vacuum cups *C* are connected to a vacuum pump, which is synchronized with the operation of the mechanism, so as to extract the air from the cups at the moment they come to rest on the plates *A* in the magazine-holder. The opening and closing of the valve are controlled through the motion of the lifting bar *Q* and the horizontal pusher-bar *X*, respectively.

At the upper end of its stroke the lifting bar *Q* opens the valve and the suction is created which grips the plates. As the lifting bar descends, projection *R* comes in contact with pin *P*, forcing it downward and raising the opposite end of lever *H*, together with the equalizing holder *D* and the plate attached. Stud *J*, guided between the projections *L*, causes the equalizing holder to rise vertically, thereby lifting the plate with a minimum amount of slipping motion between the plates.

Pin *P* passes through an arc produced by the radius or distance from the center of shaft *N* to pin *P*. The grooves in the cam-plates *S* are cut to the same radius, so that projection *R* follows pin *P* through the entire length of the arc, exerting a continual downward force on the pin. When the pin reaches the end of its downward motion, lever *H* is in a vertical position, as shown in Fig. 1 by the dot-and-dash lines. Holder *D* is also in a vertical position and resting on projection *T*, which can be adjusted to change or tilt the plane in which the plates are held.

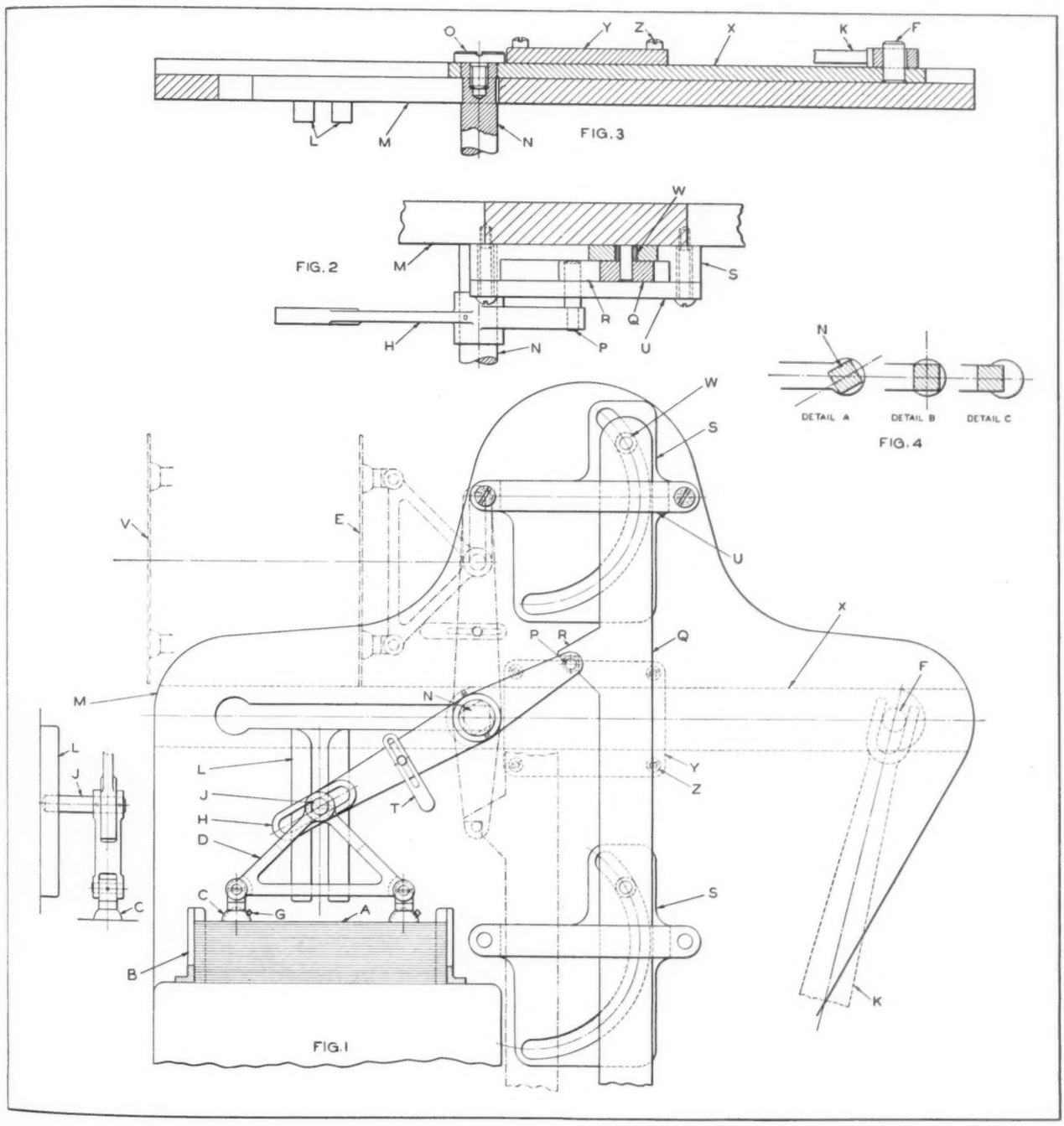
The next step in the operation is carried out by the action of the pusher-bar *X*. As soon as lever *H* is in the vertical position, the pusher-bar moves forward and carries shaft *N* with lever *H* to the end of the slot in the side plate *M*. At this point, the necessity for the square cross-section on the shaft *N* becomes obvious.

Referring to Fig. 4, details *A*, *B*, and *C* show the square section of shaft *N* in three different positions. Detail *A* indicates the position of shaft *N*

when lever *H* is in the position shown by the full lines in Fig. 1. Detail *B* shows the position of shaft *N* when lever *H* is in the position indicated by the dot-and-dash lines in Fig. 1. In this case, it will be noted that the square has been rotated so that it is in line with the slot faces. In detail *C*, the square has been moved forward and is now confined between the faces of the slot. In this manner, lever *H* is locked in a vertical position through its entire horizontal motion. Projection *R* on lifting bar *Q* is provided with a lip long enough to permit shaft *N* to enter the slot and be guided therein. When pusher-bar *X* reaches the end of its stroke, the valve controlling the vacuum in the cups is closed, breaking the vacuum and releasing the plate, which drops into its intended place.

* * *

Members of the Institution of Mechanical Engineers of Great Britain will meet in joint sessions with the American Society of Mechanical Engineers in New York, September 4 to 8. The program will include papers on light-weight, high-speed trains; marine transportation; highway transportation; and transatlantic airplane service.




**Mechanism for Automatically Picking up Plates A from Magazine and Transferring Them, One at a Time, to the Vertical Position Shown at V**

# Machine Tool Show in Cleveland will Point the Way to Good Investments

WHEN the exposition of the National Machine Tool Builders' Association, to be held in Cleveland October 4 to 13, opens its doors, it will provide visitors with an opportunity not only to view "the best equipped machine shop in the world," but also to select equipment that will prove the best type of investment at the present time. At this exposition, there will be about 175 exhibits, occupying some 140,000 square feet of floor space.

When the last Machine Tool Show was held by the National Machine Tool Builders' Association in Cleveland in 1935, the name "the best equipped machine shop in the world," applied to it by MACHINERY, proved to be no exaggeration, because all visitors agreed that there was assembled at that show the most modern machine shop equipment ever brought together under one roof.

There is no question but that the coming exposition will merit the same designation, because the past record of the machine tool building industry amply justifies the prediction that every machine on exhibit will be of the latest type, incorporating the most modern ideas in design and construction, and, furthermore, that a very large number of the machines exhibited will be shown in operation for the first time. There will be many machines of entirely new design that are just now being completed and that are undergoing rigid tests previous to the show.

The most salient point, however, is that these machines are essential to industry, not only because of their highly developed mechanical design, accuracy of performance, and convenience of operation, but because they represent cost-reducing possibilities more important today than ever before, due to the greatly increased costs of manufacture represented by higher taxes and increased labor costs. The machine tool industry is staging this exposition with the view of presenting a line of equipment that represents not merely machines, but advantageous investment possibilities.

The slogan "your smartest investment today—better machine tools" is no idle saying. Good financial investments are scarce today. Hence shop equipment that points the way to lower costs, and consequently to better returns on capital, is an investment possibility well worth the most careful consideration. The Cleveland show, to be held next October, provides a most convenient means for studying these investment possibilities. After all, modern machine tools are improved not only with the view of providing better mechanical production means, but also to offer an opportunity to offset the constant increases in taxes, and in labor and material costs.

# How Machine Tools Affect the Life of the Average Man

THE National Machine Tool Builders' Association, 10525 Carnegie Ave., Cleveland, Ohio, has published, in booklet form, the address "Machine Tools and You" given before the Army Industrial College at Washington by Howard W. Dunbar, past-president of the Association and vice-president and general manager of the Grinding Machinery Division of the Norton Co., Worcester, Mass. This address begins by pointing out that without machine tools—the master tools of industry—it would be impossible to produce commercially almost any of our everyday necessities and luxuries. The booklet then proceeds to explain the relation between modern machine tools and present-day industry, showing how the machine tool is the mother of mass production, which, in turn, has made present-day civilization possible. Without the machine tool and without mass production, our standard of living would be approximately what it was in 1840.

It is also emphasized that while the defense program of our Government rests ultimately upon the machine tool industry, since no defense equipment could be produced without machine tools, the machine tool industry, as such, is dedicated to the arts of peace, and by far the largest proportion of the output of the industry is used for the manufacture of the thousand and one products that have created the comforts and luxuries that we comprehensively include in the term "the American standard of living."

* * *

According to the *World Machinery News*, published by the Machinery Division of the Bureau of Foreign and Domestic Commerce, British machine tool exports in 1938 again exceeded imports. For a period of nearly two years previously, the demand for machine tools far exceeded the domestic supply, but during 1938, this condition began to change, as imports declined and exports increased.

# Associated Machine Tool Dealers Hold Spring Convention

THE Associated Machine Tool Dealers of America held their spring meeting at the Van Curler Hotel, Schenectady, N. Y., June 5 and 6. A program covering many of the problems of both machine tool distributors and machine tool builders was presented at the unusually well attended convention.

The keynote message of the meeting was delivered by the president of the Association, A. G. Bryant, president of the Bryant Machinery & Engineering Co., Chicago, Ill. In his address, entitled "From Builder to Salesman to User," Mr. Bryant covered a wide range of topics. He referred to the importance of the machine tool industry because of the key position that it occupies; he called attention to the drastic fluctuations that always take place in this industry with changes in business conditions; he emphasized the importance of sound marketing methods and the place in the marketing program of the sales engineer; he stressed the importance of the sales assistance given the dealer and his salesmen by the manufacturer; and closed his address by an appeal to the users of machine tools to recognize the importance of cooperating with the machine tool distributor and builder.

A. G. Bryant, President of the Associated Machine Tool Dealers of America

Among other outstanding addresses made at the meeting were "Profit Selling," by Wendell E. Whipp, president of the National Machine Tool Builders' Association and president of the Monarch Machine Tool Co., Sidney, Ohio; "How the Machine Tool Dealer Serves the Machine Tool Buyer," by B. G. Tang, general superintendent, Schenectady Works, General Electric Co.; "Engineering Contributions to Industry," by R. C. Muir, vice-president in charge of engineering of the General Electric Co.; "Assisting in Machine Tool Sales," by J. E. N. Hume, commercial vice-president, Industrial Department, General Electric Co.; and "How Improved Machine Tools Have Helped Us," by P. W. Brown, general superintendent, Wright Aeronautical Corporation, Paterson, N. J.

At the dinner given in connection with the meeting two thought-provoking addresses were made, one by Dr. James S. Thomas, president of the Chrysler Institute, Detroit, Mich., and of the Clarkson College of Technology, Potsdam, N. Y., on "New Frontiers for Smart People"; and the other by John H. Van Deventer, editor of the *Iron Age*, entitled "The Lost Generation and What It Means to You."

The meeting included an inspection trip through the General Electric Works.

# Carpenter Steel Co. Celebrates Fiftieth Anniversary

IT was on June 7, 1889, six days after the organization of the Carpenter Steel Co., that James H. Carpenter and a small group of men, a few of whom are still living, began making steel at Reading, Pa. By the end of the year, there were sixty-two men on the payroll, and from that time on, the company has steadily grown, becoming an important factor in the production of tool and alloy steels.

A considerable addition to the plant was made in 1913, when three open-hearth furnaces were completed. In 1917, when the first electric heat was poured, the third and most modern unit of melting was added. During the World War, the company was operating twenty-four hours a day, with a payroll numbering 2400 men.

The Carpenter Steel Co. was one of the pioneers to introduce stainless steel in industry. One of the difficulties experienced with this steel at first was in machining it. After a long period of research and study, the company introduced to the trade, in 1928, Carpenter stainless steel No. 5, a free-machining stainless steel.

The progress of the Carpenter Steel Co., founded, as it was, at a time when the steel industry entered into a new and more scientific stage, has paralleled the epoch-making events in the industry during the last fifty years.

# Kerosene-Lubricated Wheel-Spindles Increase Accuracy and Production

FOR more than two and a half years, the experimental laboratory of the Norton Co., Worcester, Mass., has been conducting tests to determine the possibilities of kerosene lubrication of grinding wheel spindle journals and practical applications of this type of lubrication. These tests, together with tests made in the field under actual production conditions, revealed a number of outstanding advantages for kerosene-lubricated journals, especially those that had been given a mirror-like finish.

As a result of the vast amount of experimental work and practical testing done, all Norton grinding machines equipped with plain-bearing, automatically lubricated wheel-spindles, are now being made for kerosene lubrication of the spindle journals. This type of lubrication, however, is recommended only for plain bearings to which an ample flow of lubricant is delivered. It is not recommended for drip-lubricated bearings. Ball-bearing spindles supplied by the Norton Co. will continue to be lubricated with a light oil having a Saybolt rating of 60 seconds at 100 degrees F.

Kerosene lubrication can be used on Type B, BA, and C machines now in service with no alterations other than a change of oil and a setting up of the bearings, if they are in good condition. If the bearings are not in good condition, rescraping is recommended.

The spindle journals of the Norton machines now built for kerosene lubrication are finished by methods that give them a highly reflective mirror-like surface, as shown in Fig. 1. The surfaces thus finished are accurate in size and straightness to 0.0001 inch, and show readings from 1 to 2 microinches on the Profilometer.

While kerosene has been used for many years as a spindle lubricant in the high-speed internal spindles supplied with Norton tool and cutter grinders, a high-quality oil with a Saybolt viscosity rating of from 60 to 185 at 100 degrees F. has previously been employed for the spindles of external grinders which operate at speeds ranging from about 800 to 1800 R.P.M., depending on the grinding wheel diameter. From 0.001 to 0.002 inch clearance for oil was provided in the bearings, and a bearing temperature of about 140 degrees F. was considered normal. With kerosene lubrication, these clearances can be safely reduced to approximately one-fifth of that formerly provided, and the temperature of the bearing will not rise much, if any, above 100 degrees F.

The chart shown in Fig. 2, made in April, 1938, shows a record of spindle oil and machine temperatures over a period of one week. The difference between the temperature of the oil and of the machine and the fluctuations of both each time the machine was started and stopped are significant. It will be noted that it was twenty-four hours before the oil temperature dropped to the machine temperature when the machine was shut down for the week-end.

The chart shown in Fig. 3 was made in July, 1938, on the same machine with a kerosene-lubricated spindle. This chart shows that the kerosene temperature does not rise above 100 degrees F. It will be noted that with kerosene lubrication the fluctuations in temperature are very slight. Consequently, the repetitive expansion and contraction changes of the grinding wheel unit elements are greatly reduced.

Tests have shown that kerosene-lubricated spindles produce an improved finish on the work more quickly. The accuracy of the work is also increased, so that closer tolerances are assured. In an automotive plant, for example, the product was improved and production increased 12 per cent when

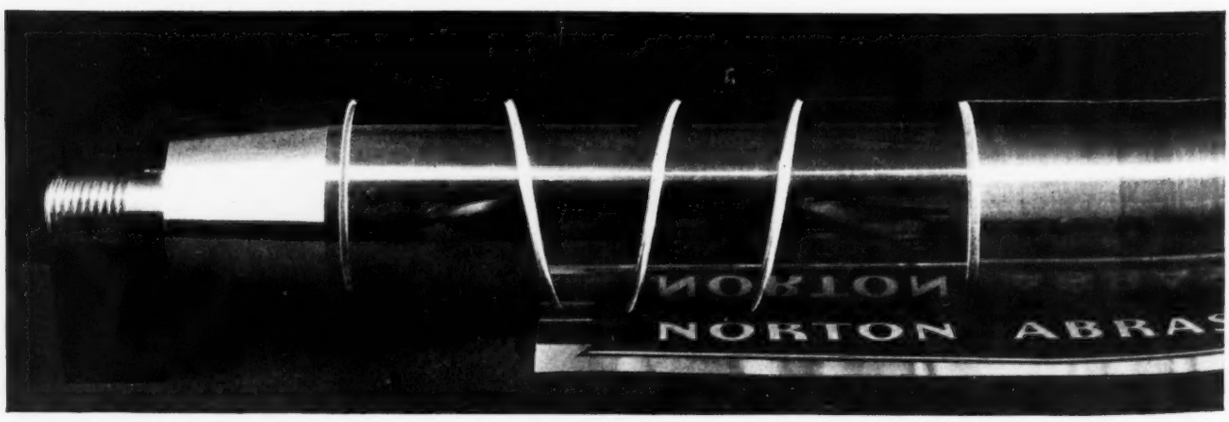



Fig. 1. Reproduction of Unretouched Photograph of Norton Grinding Machine Spindle Finished for Kerosene Lubrication

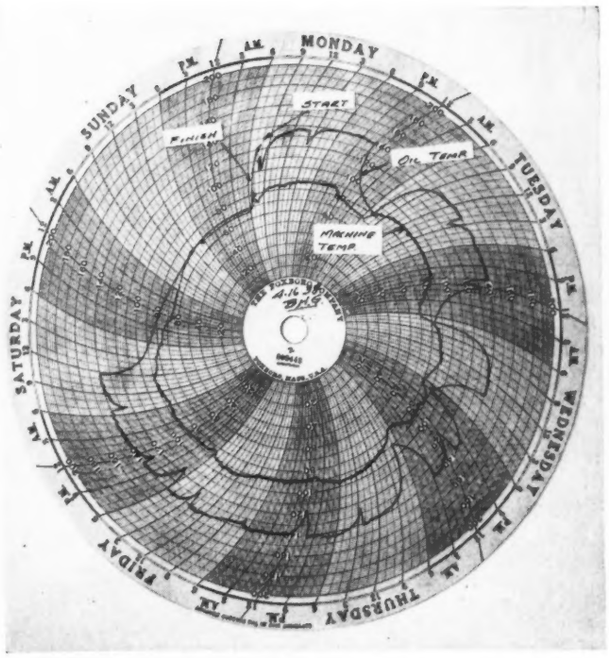



Fig. 2. Chart of Oil and Machine Temperatures with Grinding Spindle Lubricated by Oil

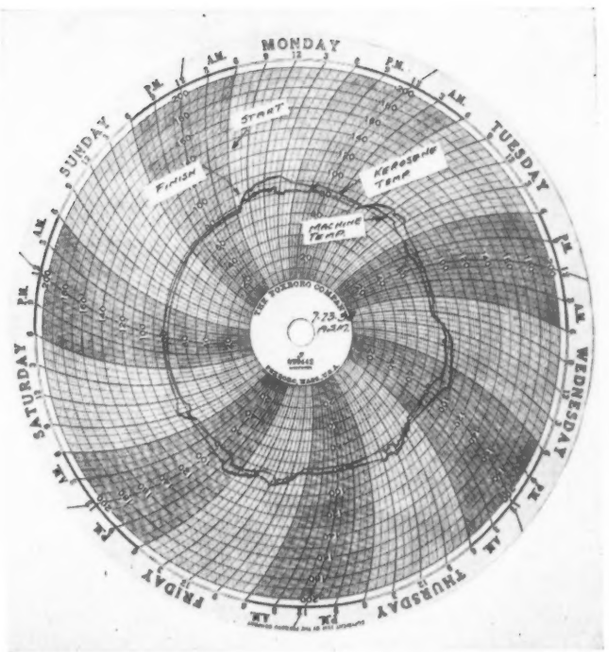



Fig. 3. Chart of Oil and Machine Temperatures with Grinding Spindle Lubricated by Kerosene

the new kerosene-lubricated spindles were employed. In an aviation motor plant, the production was increased and the work held to a limit of 0.0001 inch as easily as it had formerly been held to a limit of 0.0002 inch.

Generally a wheel one grade softer can be specified with no loss in production and at no increase in wheel cost when kerosene-lubricated grinding machine spindles are used. In one case, the number of pieces per wheel dressing was increased from 35 to 50. Tests show that, while maintaining the same production, there is less wear of the bearings and fewer adjustments are required.

As an experiment, the kerosene-lubricated spindle bearings were purposely set close to cause spindle seizure, but not the slightest injury to the spindle or bearings could be detected by close inspection. No rescraping of the bearing nor refinishing of the spindle journals was necessary as a result of this test.

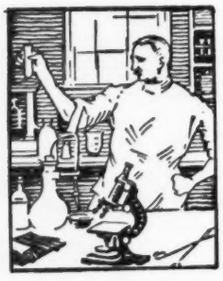
In another case, the spindle bearings were set so close that a considerable leverage was required to enable a man to turn the spindle by hand. When power was applied to this spindle, it ran smoothly and satisfactorily. A great amount of data already accumulated indicates that kerosene-lubricated grinding spindles will increase production at least 10 per cent in practically every case.

# New Departure Celebrates Fiftieth Anniversary

ON June 27, the New Departure Division of the General Motors Corporation, Bristol, Conn., manufacturer of ball bearings at Bristol and Meriden, celebrated the fiftieth anniversary of the founding of the company, combining its annual Old Timers Party with a dinner for foremen and executives. Alfred P. Sloan, Jr., chairman of the board, and W. S. Knudsen, president of the General Motors Corporation, made the principal addresses, while F. G. Hughes, general manager of the New Departure Division, gave a talk entitled "No One of Us Is As Smart As All of Us." Hamilton watches were presented to 30 employes who had completed a quarter century service with the New Departure Division; 97 employes received gold service buttons for 20 years service.

The New Departure Co. was formed in 1889, when a single room was rented and half a dozen men and women were employed to assemble a doorbell which, operated by a clockwork mechanism, gave "electrical results without a battery." So successful was this venture that two years later the company moved into a larger brick building and began the manufacture of bicycle, tea, car, and fire bells. With the advent of the bicycle era, cyclometers and a free-wheel braking device were added. These features later developed into the world's first bicycle coaster-brake. About 1908, the company began to manufacture ball bearings, which is now the company's chief product. In this field, New Departure has pioneered many developments of great importance.

# MATERIALS OF INDUSTRY



THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

## Metal and Plastic Shapes as Thin as One Sixty-Fourth Inch

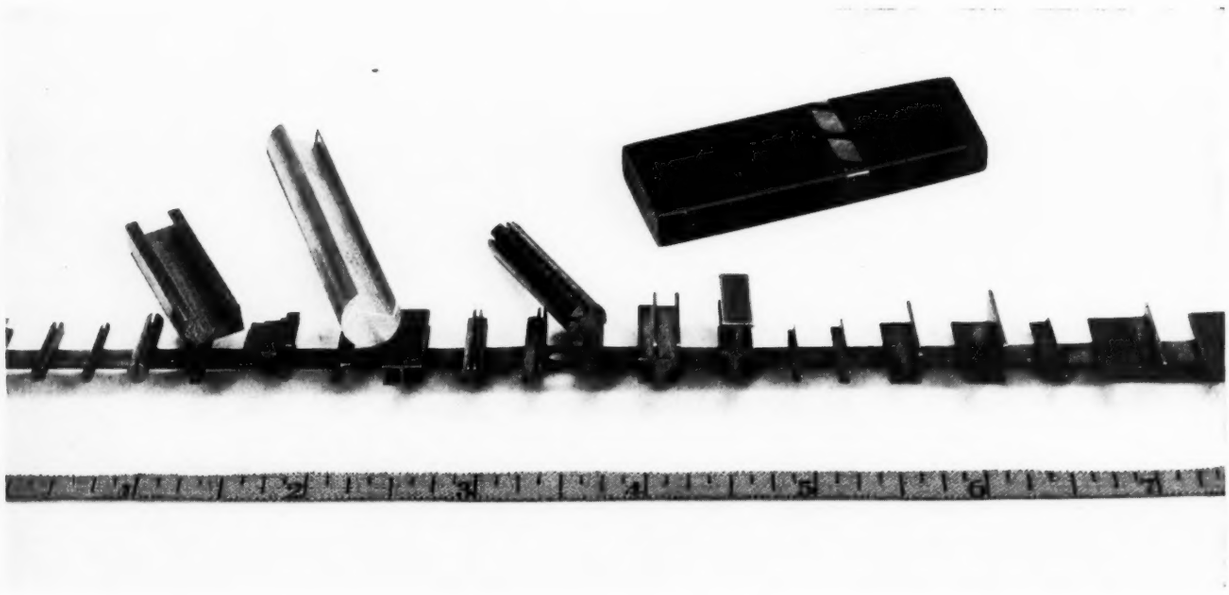
Shapes of ferrous, non-ferrous, and plastic materials, with sections as thin as 1/64 inch, that are finished to tolerances as close as 0.002 inch have been made available by Precision Shapes, Inc., 330 W. 42nd St., New York City. The illustration indicates the large variety of shapes obtainable by means of a special manufacturing process. These shapes are supplied in unlimited lengths and are of particular value to craftsmen, marine architects, engineers, and others who may wish to produce true-to-scale models of railway equipment, ships, utility projects, and so on.

Some of the shapes are exact replicas in miniature of well-known structural steel shapes, and they thus enable true-to-scale models of bridges, buildings, cranes, and other structures to be made. They are fabricated from bar stock and tube material which can be cut to desired lengths by a simple operation.

Most of the shapes shown in the illustration are of brass or steel, but several are of a colorless plastic. At the upper right may be seen a piece of black plastic material with an embedded brass shape. . . . . 201

## Beryllium Alloys Available in Heat-Treated Rod, Strip, and Wire

The Beryllium Corporation of Pennsylvania, Reading, Pa., which hitherto has supplied master alloys only in ingot and cast form, has completed facilities for the commercial production of heat-treated beryllium alloys in rod, strip, and wire forms. It will be possible to obtain 2 to 2.25 per cent beryllium-copper, beryllium-cobalt-copper, beryllium-chromium-copper, beryllium-nickel, and other alloys in primary fabricated shapes. Rod and wire is being supplied at present in diameters from 0.020 inch up to 1 1/4 inches, and strip stock in widths from 1/8 inch to 4 inches and in thicknesses from 0.010 to 1 inch.



Precision Shapes of Ferrous, Non-ferrous, and Plastic Materials Obtainable with Sections as Thin as 1/64 Inch and Machined to Tolerances as Close as 0.002 Inch



To obtain additional information about materials described on this page, see lower part of page 806.

These beryllium-alloy products should be of particular interest to the manufacturers of electrical devices, small machine parts, springs, aviation instruments, business machines, and other products requiring non-ferrous metals possessing high electrical conductivity and tensile strength; elastic stability; resistance to fatigue, heat, and wear; and uniform hardening characteristics.

The properties of beryllium alloys make them difficult to fabricate into primary shapes with ordinary mill equipment, and the maker states that it is for this reason that the range of available analyses has been limited and delivery uncertain heretofore. With the new facilities, the company is able to fabricate the beryllium-alloy rod, strip, and wire under close laboratory control of all physical properties. Uniform hardening is obtainable. Some of the beryllium-copper alloys have an electrical conductivity as high as 70 per cent that of copper. ..... 202

## Molybdic-Oxide Briquettes for Adding Molybdenum to Iron and Steel

Molybdic-oxide briquettes composed of a mixture of molybdenum trioxide and a sulphur-free pitch binder were originally brought out by the Climax Molybdenum Co., New York City, to provide an economical and convenient means of adding molybdenum to cast iron, either in the cupola or in electric or air furnaces. However, these briquettes were found also to possess advantages as a means of adding molybdenum to steel. They are 3 1/2 inches in diameter by 4 1/2 inches long, and weigh about 5 pounds each. Although the molybdenum content may vary, adjustments in size and weight are made so that every briquette contains exactly 2 1/2 pounds of metallic molybdenum.

These briquettes are being used under ordinary working conditions to produce iron containing molybdenum in amounts up to 2 per cent and for producing molybdenum steels of various types. There is no carbon "pick up" in either case....203

## New Castable Refractory Material for Furnaces

As a result of development work on castable refractory materials, Johns-Manville, of New York City, has added to its line of Firecrete products a new light-weight material for use in making special refractory shapes, replacing difficult brick construction, lining furnace doors, and making small monolithic linings. This product is suitable for working temperatures up to 2200 degrees F. Laboratory and service tests have shown that it possesses an exceptionally low heat storage capacity, which is especially advantageous in the case of intermittently operated furnaces.

Sixty-five pounds of the material are required per cubic foot of finished construction. Any refractory shape is obtainable in a short time by simply mixing "Light-Weight" Firecrete with water and casting it in a form. After being in the form twenty-four hours, the shape is ready to be placed in service. ..... 204

## Heating Characteristics of Magalloy Magnesium-Alloy Castings

Short-time heating of Magalloy magnesium-alloy castings at temperatures up to 300 and 400 degrees F., as in the baking on of enamel, has no appreciable effect on the properties of the castings after they have been brought back to room temperature, according to the Magnesium Fabricators Division of the Bohn Aluminum and Brass Corporation, Detroit, Mich. The shrinkage of Magalloy castings is about the same as that of aluminum alloys.

About 70 per cent of the sand magnesium castings made in this country are used by the airplane industry. The remainder are employed for portable tools, assembly jigs and fixtures, foundry flasks, patterns, core-boxes, reciprocating engine and machinery parts, circuit-breaker parts, crankcases, transmission cases, street-car motor housings, fans, riveting equipment, and hand tools.....205

The world's first "glass" automobile has made its appearance at the New York World's Fair. This car is a Pontiac Six, with a transparent "Body by Fisher." The fenders, hood, radiator, and all door and body panels ordinarily made of sheet steel are made from a glass-like plastic material through which the engine, the interior bracing of the turret top, and other construction details are visible. The windows can be raised and lowered, the doors opened and closed, and the car can be driven.

To obtain additional information about materials described on this page, see lower part of page 806.

# NEW TRADE LITERATURE

*Recent Publications on Machine Shop Equipment, Unit Parts and Materials. To Obtain Copies, Check on Form at Bottom of Page 805 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the July Number of MACHINERY*

### Disk Grinders

GARDNER MACHINE CO., Beloit, Wis. Catalogue entitled "Modern Methods of Gardner Grinding," showing typical operations on Gardner machines, ranging from simple hand-operated disk grinders and fixtures to high-production single-purpose machines. Production rates and tolerances are given for the various jobs illustrated, indicative of the possibilities of these machines. 1

### Plastic Materials

PLASKON CO., INC., Toledo, Ohio. Handbook for manufacturers, engineers, and designers in the plastics industry, containing 82 pages of technical data, halftones, diagrams, and drawings covering every phase of the field of applied plastics, together with numerous important tables useful to engineers and designers. 2

### Physical Properties of Steels

JOSEPH T. RYERSON & SON, INC., 16th and Rockwell Sts., Chicago, Ill. Physical properties chart, giving tensile strength, yield point, elongation, hardness, etc., of nearly fifty different types of steel. The data is compactly presented on an 8 1/2-by 15-inch chart, which is especially convenient for use under a desk glass. 3

### Power Transmission Equipment

LINK-BELT CO., 307 N. Michigan Ave., Chicago, Ill. Handbook 1600, containing 272 pages on modern power transmission equipment, covering ball and roller bearings; babbitted bearings; clutches, including the newly acquired Twin Disc line; gears; pulleys; shafting; couplings; hangers, etc. 4

### Single-Spindle Automatics

CLEVELAND AUTOMATIC MACHINE CO., 2269 Ashland Road, Cleveland, Ohio. Catalogue illustrating and describing the new Cleveland single-spindle automatic. Profusely illustrated, the catalogue clearly describes the main features of construction and operation of this machine. 5

### Die Steel

CRUCIBLE STEEL CO. OF AMERICA, 405 Lexington Ave., New York City. Bulletin describing "Airkool" die steel, a newly developed steel with easy machineability, great toughness, and marked resistance to distortion or warpage. 6

### Cleaning of Steel Before Plating

OAKITE PRODUCTS, INC., 26 Thames St., New York City. Treatise entitled "The Cleaning of Polished Steel Before Plating," describing a new development that makes practical the cleaning of polished steel in one operation. 7

### Oils and Lubricants

SUN OIL CO., 1608 Walnut St., Philadelphia, Pa. Booklet entitled "Serving Industry," covering petroleum products for all industries, including lubricating oils, cutting lubricants, processing oils, and fuel oils. 8

### Speed Transmissions, Tools, and Shop Equipment

IDEAL COMMUTATOR DRESSER CO., Sycamore, Ill. 84-page catalogue and handbook describing motor and other maintenance equipment and electrical specialties, covering a wide range of shop equipment. 9

### Roller Bearings

HYATT BEARINGS DIVISION, GENERAL MOTORS SALES CORPORATION, Harrison, N. J. Catalogue covering Hyatt roller-bearing railroad journal boxes for modern high-speed service. This is a handsomely bound, unusually well illustrated book. 10

### Drafting-Room Equipment

EBERBACH & SON CO., Ann Arbor, Mich. Circular illustrating and describing the "Portaprint," a machine that will produce positive prints directly from originals in four minutes at a cost of less than two cents each. 11

### New and Rebuilt Machinery

J. L. LUCAS & SON, INC., Bridgeport, Conn. Bulletin N51, covering bench drills, grinders and milling machines, "Excelsior" drilling machines, and Taylor-Hall spot welders. Bulletin 102S, listing used machines of late models. 12

### Profile Grinders

BOYAR-SCHULTZ CORPORATION, 2110 Walnut St., Chicago, Ill. Folder illustrating and describing heavy-duty precision profile grinders, applicable for the grinding of inside and outside contours, as well as general grinding on tools, dies, and machine parts. 13

### Variable-Speed Transmission

SPEEDMASTER CO., DIVISION OF CONTINENTAL MACHINES, INC., Minneapolis, Minn. Bulletin and leaflet illustrating and describing the Speedmaster, a variable-speed device with an infinite number of speeds. 14

### Grinding Wheels

NORTON CO., Worcester, Mass. 75-page book entitled, "Facts About Grinding Wheels," covering grinding wheels, reference tables, wheel selection, and general grinding information. 15

### Small-Plant Switchboards

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. Descriptive Data 31-132 and 31-133, on small plant and industrial switchboards, of direct and alternating current type, respectively. 16

### Lubricating Systems

BOWEN PRODUCTS CORPORATION, Auburn, N. Y. Catalogue 75, describing the operation and installation of the Bowen high- and low-

pressure hydraulic-automatic lubricating systems. ..... 17

### Presses

NIAGARA MACHINE & TOOL WORKS, Buffalo, N. Y. Bulletin illustrating Niagara presses, entitled "How These Smaller Size Niagara Inclinable Presses are Built for Men Who Appreciate Good Design." ..... 18

### Wrenches

J. H. WILLIAMS & Co., 225 Lafayette St., New York City. Booklet entitled "How to Select and Use Wrenches," containing much valuable information relating to wrenches, their use and application. ..... 19

### Bearing Bronze

JOHNSON BRONZE Co., 520 S. Mill St., New Castle, Pa. Catalogue L-1, entitled "Johnson Ledaloyl Self-Lubricating Bearing Bronze," listing over 300 sizes available in stock, and giving installation data. ..... 20

### Motor Drives

QUALITY HARDWARE MACHINE CORPORATION, 5849 Ravenswood Ave., Chicago, Ill. Folder illustrating and describing self-contained motor drives applicable to various types of machine tools already installed. ..... 21

### Flexible Couplings

MORSE CHAIN Co., Ithaca, N. Y. Bulletin 57, giving complete information on the design, dimensions, and applications of the numerous types of flexible couplings made by the company. ..... 22

### Alloy Iron Pipe

REPUBLIC STEEL CORPORATION, Cleveland, Ohio. Two-color 44-page catalogue entitled "Toncan Iron Pipe for Tough Service," giving complete description, specifications, and applications. ..... 23

### Heat-Treated Gearing

WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa. Technical data booklet 71-000 on Westinghouse-Nuttall heat-treated hardened gearing, covering materials, heat-treatment, and physical properties. ..... 24

### Hardness Conversion Table

INTERNATIONAL NICKEL Co., INC., 67 Wall St., New York City. Handy pocket table, giving hardness conversion numbers for nickel alloy steels, as well as the S A E standard specifications for these steels. ..... 25

### Hollow-Head Cap-Screws

ALLEN MFG. Co., Hartford, Conn. Catalogue giving up-to-date information on the complete line of Allen hollow screw products and the application of the cold-forming process to hollow-head cap-screws. ..... 26

### Bending Machines

PEDRICK TOOL & MACHINE Co., 3640 N. Lawrence St., Philadelphia, Pa. Bulletin entitled "Pedrick Bending Machines — Compression Bent," describing the various models made by the company. ..... 27

### Precision Bench Lathes

RIVETT LATHE & GRINDER INC., Brighton, Boston, Mass. Bulletin 505-E, covering the Rivett 505 series of plain precision bench lathes and hand screw machines, including attachments, mountings, and drives. ..... 28

### Protective Shields and Goggles

LINCOLN ELECTRIC Co., Cleveland, Ohio. Bulletin 350, treating on the protection of the eyes in welding by the use of the Lincoln "Super-Visibility" and "High-Visibility" lens. ..... 29

### High-Strength Iron

CLIMAX MOLYBDENUM Co., 500 Fifth Ave., New York City. Section 5 of a book on "Molybdenum in Cast Iron," entitled "High Strength and Heavy Sections." ..... 30

### Texrope Drives

ALLIS-CHALMERS MFG. Co., Milwaukee, Wis. Circular illustrating typical cost-reducing installations of Allis-Chalmers Texrope drives and "Lo-Maintenance" motors. ..... 31

### Tool Steel

A. MILNE & Co., 745 Washington St., New York City. Chart entitled "The Tool Steel Selector," giving valuable data pertaining to many different types of tool steel. ..... 32

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## To Obtain Copies of New Trade Literature

**listed on pages 804-806 (without charge or obligation) mark with X in the squares below, the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail to:**

**MACHINERY, 148 Lafayette St., New York, N. Y.**

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### End-Mills

UNION TWIST DRILL CO., Athol, Mass. Catalogue entitled "Union End-Mills—Double End, Single End, Ball End," giving dimensions and price lists. ..... 33

### Shims

LAMINATED SHIM CO., INC., 21-86 Forty-fourth Ave., Long Island City, N. Y. Application chart listing numerous applications for laminated shims or shim stock. ..... 34

### Metal-Sawing Machinery

TANNEWITZ WORKS, Grand Rapids, Mich. Catalogue illustrating and describing the Model 24M Di-Saw for continuous sawing, filing, or polishing operations. ..... 35

### Precision Measurements

SHEFFIELD GAGE CORPORATION, Dayton, Ohio. Leaflet covering the Sheffield visual precision gage which makes use of the Reed mechanism and a beam of light. ..... 36

### Metal Spraying

METALLIZING CO. OF AMERICA, INC., 1351 E. 17th St., Los Angeles, Calif. Booklet giving information on metal spraying, with illustrations of applications. ..... 37

### Electric Hoists

SHAW-BOX CRANE & HOIST DIVISION, MANNING, MAXWELL & MOORE, INC., Muskegon, Mich. Bulletin 343, covering Shaw-Box portable electric "Budgit" hoists. ..... 38

### Plastic Knobs and Handles

IMPERIAL MOLDED PRODUCTS CORPORATION, 2925 W. Harrison St., Chicago, Ill. Bulletin illustrating and describing a large variety of plastic knobs and handles. ..... 39

### Superfinishing Machines

NORTON CO., Worcester, Mass. Folder entitled "Superfinishing with Norton Machines and Norton Stones and Wheels." ..... 40

### Variable-Speed Controls

COLUMBIA VARI-SPEED CO., Liberty Bldg., Wheaton, Ill. Catalogue illustrating and describing the company's JFS-Jr. Vari-speed controls. ..... 41

### Speed Reducers

STEPHENS-ADAMSON MFG. CO., Aurora, Ill. Catalogue 7838, containing complete engineering information on Saco speed reducers. ..... 42

### Electric Furnaces

HAROLD E. TRENT CO., 618-640 N. 54th St., Philadelphia, Pa. Leaflets 11-TF and 20-TG, covering electric furnaces and ovens. ..... 43

### Anchorage for Bolts and Screws

RAWLPLUG CO., INC., 98 Lafayette St., New York City. Catalogue 39, entitled "A Better Anchorage for Bolts and Screws." ..... 44

### Electric Heating Equipment

GENERAL ELECTRIC CO., Schenectady, N. Y. Bulletin GES-2203, entitled "Built-in Electric Heat Makes Machines Easy to Use." ..... 45

### Roller Bearings

BOWER ROLLER BEARING CO., 3040 Hart Ave., Detroit, Mich. Dimension sheets covering single-row tapered roller bearings. ..... 46

### Hoists

COFFING HOIST CO., Danville, Ill. Circular illustrating and describing the new Coffing "Quik-Lift" electric hoist. ..... 47

### Portable Grinders

ROTOR TOOL CO., Cleveland, Ohio. Catalogue 19, covering the company's four new "Powerplus" air grinders. ..... 48

### Abrasives

ABRASIVE PRODUCTS, INC., South Braintree, Mass. 40-page catalogue covering coated abrasive papers and cloths. ..... 49

### Speed Control and Transmission

REEVES PULLEY CO., Columbus, Ind. Folder descriptive of the Reeves variable-speed control. ..... 50

### Machine Shop Tools

BONNEY FORGE & TOOL WORKS, Allentown, Pa. Catalogue 39, containing 91 pages on Bonney tools for all classes of machine work. ..... 50-A

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## To Obtain Additional Information on Shop Equipment

**Which of the new or improved equipment described on pages 807-823 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment mark with X in the squares below, the identifying number found at the end of each description on pages 807-823—or write directly to the manufacturer, mentioning machine as described in July MACHINERY.**

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# *Shop Equipment News*

*Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market*

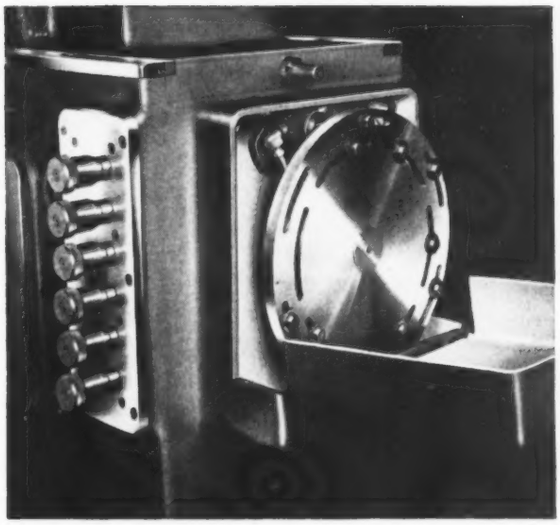


Fig. 1. Micrometer Adjusting Screws and Trip-dog Disk for Controlling Feed and Rapid Traverse Movements of Footburt Automatic

## Footburt Automatic Single-Spindle Screw Machine

Hydraulic feed with controls designed for rapid change-over in setups for small runs is an outstanding feature of the No. 1 1/2 automatic single-spindle screw machine brought out by the Foote-Burt Co., Cleveland, Ohio. The spindle of this machine is equipped with an improved chuck and has automatic speed changes, including two forward and two reverse speeds. It is possible to reverse the spindle at low speed and immediately trip it to obtain a high reverse speed, thus permitting the use of a simple tap-holder.

The turret has six holes, and is indexed by a Geneva motion capable of operating through a complete cycle in eight seconds. The feed-cam controls for both the rate and length of feed are conveniently located and arranged for quick changes, as shown in Fig. 1. The six micrometer screws shown in this illustration, one for each turret position, can be adjusted to a fine degree of accuracy for the slow feed. The location of the two trip-dogs on the disk governs the points at which the slow feed and the rapid traverse movements are engaged.

The turret is arranged so that oil-feed drills and reamers may be used, the coolant to these tools being automatically controlled. The cross-slides are fed by a cam disk, a screw adjustment and adjustable stops being provided for the depth of feed for each slide. An enclosed motor drives a horizontal shaft from which V-belts are connected to the machine drive. The horizontal shaft also drives a hydraulic pump which, in turn, drives the hydraulic motor so that the drive and feed of the machine are from the one motor drive.

The stock feed and chuck are operated by a cam drum that advances the feed-tube and controls the clamping action of the collet jaws. The chuck capacity is 1 5/8 inches; stock feed, 14 inches; milling length, 6 inches; and turret adjustment, 4 inches. Spindle speeds range from 30 to 1000 R.P.M. for steel, and from 60 to 2000 R.P.M. for brass. The motor drive through V-belts is furnished by a 7 1/2-H.P. motor running at a speed of 1800 R.P.M. The machine occupies a floor space 32 1/2 inches by 105 inches.....51

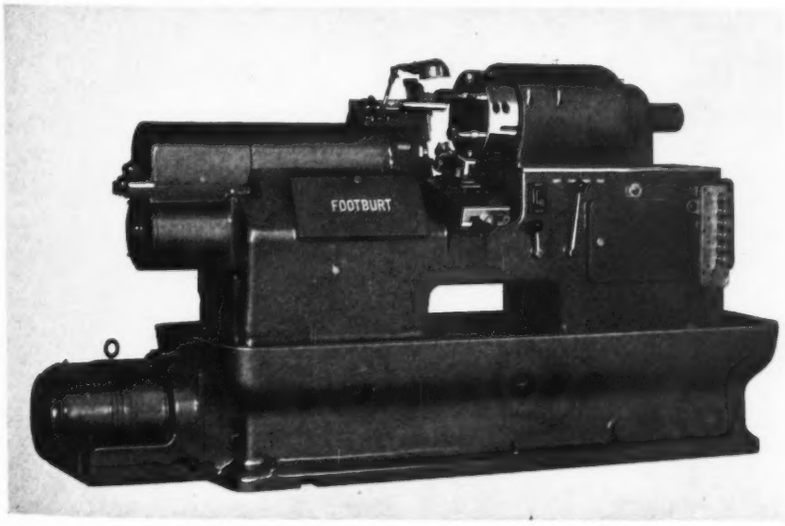



Fig. 2. Footburt Automatic Single-spindle Screw Machine Developed to Reduce Production Costs on Small Runs

To obtain additional information on equipment described on this page, see lower part of page 806.

## Simplex Precision Boring Machine

The Stokerunit Corporation, 4548 W. Mitchell St., Milwaukee, Wis., has developed a 200 series Simplex precision boring machine especially arranged for flexibility and versatility in performing fine boring and facing work. The lower part of the base houses the electrical control panel and the coolant tank, and supports the rubber pads on which the upper portion of the bed proper is mounted. The rubber pads between the two base members insulate the machine from floor vibration.

The distance between the bridges mounted at each end of the bed can be adjusted from 19 to 35 inches. From one to four spindles can be mounted on each bridge and driven by V-belts from a rubber-mounted motor above the bridge. The normal spindle speed range is from 250 to 3500 R.P.M.; the normal distance from the spindle to the table is 6 inches, but this distance can be increased.

The table is 13 inches wide by 54 3/4 inches long. The table feed is obtained from a gear motor driving through a set of pick-off gears and a feed-screw beneath the table. The solenoid-operated reduction gearing provides a fine feed for facing or heavy boring, and by means of a pneumatic time relay for each direction of feed, permits facing to a positive stop. Manual movement of the table is obtained by a large handwheel. The feeding range is 16 inches in either direction, and feeds from 1 1/2 to 15 inches per minute are available. The facing feed is normally 20 per cent that of the regular table feed being used. The machine weighs approximately 4500 pounds. ..... 52

## Device for Interrupting Spot-Welding Currents without Noise

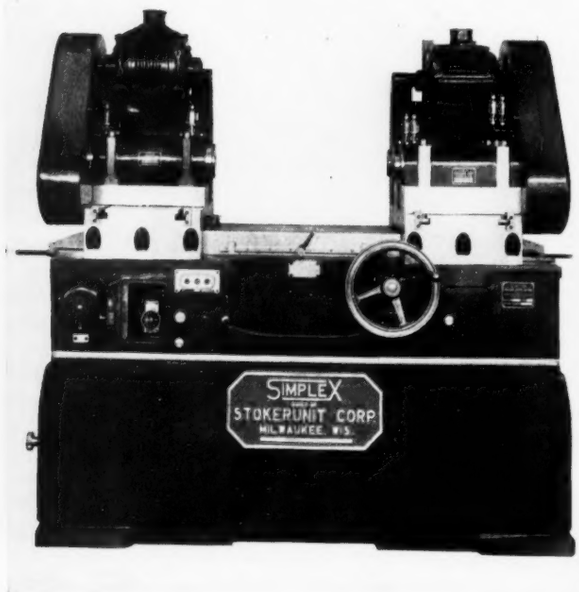
The noise associated with spot-welding can be eliminated by means of a device developed by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The spot-welding currents are interrupted without noise, using no moving contacts, by means of two metal tubes about the size of giant fire-crackers. These tubes operate on the principle of the ignitron timer; however, in this instance, the tubes serve no timing function, but act simply as switches or contactors. They stop the current flow at the end of each half-cycle and do not permit it to start on the next unless the tube, so to speak, gets its signal through the ignitor. The ignitor is controlled, in the usual manner, by a foot switch or electronic timer. ..... 53

## Foster General-Purpose Superfinishing Equipment

A machine for superfinishing cylindrical surfaces up to 4 inches in diameter and 18 inches in length, or shorter lengths up to 6 inches in diameter, is being built by the Foster Machine Co., Elkhart, Ind. The headstock of the machine can be equipped either for handling the work on centers or for holding it in a collet or chuck. The drive to the spindle is obtained through a variable-speed transmission arranged for an infinite number of spindle speeds up to 550 R.P.M.

This machine is being used for a wide variety of processes, including work in airplane plants, automobile plants, tool and die shops, a sewing machine manufacturing plant, and several others. It is adapted for superfinishing leader pins and die sets, broaches and reamer flutes, cylindrical gages, draw-mandrels, pump pistons and shafts that pass through packing, motor armature shaft bearings, and any cylindrical work within the capacity of the machine, even the superfinishing of bearings on small crankshafts.

The machine shown in Fig. 1 has been developed to enable every manufacturing plant to obtain the advantages of superfinished surfaces reading as low as 2 micro-inches surface roughness on the Profilometer. This company has also developed the superfinishing head shown in Fig. 2, which is made in three




Simplex Precision Boring Machine Built by the Stokerunit Corporation

Fig. 1. Foster General-purpose Superfinishing Machine for Cylindrical Work



To obtain additional information on equipment described on this page, see lower part of page 806.

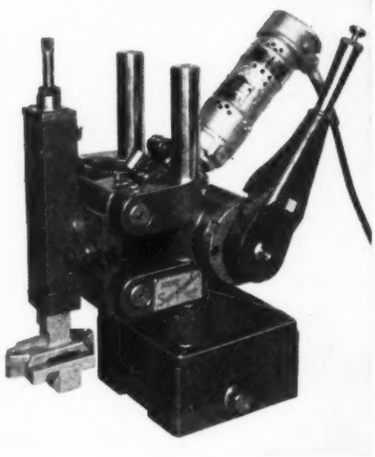


Fig. 2. Foster Superfinishing Head Designed for Use on a Lathe

sizes to accommodate work up to several feet in diameter. The superfinishing heads are mounted on the compound rest of an engine lathe cross-slide. With this arrangement, practically any cylindrical work within the capacity of the lathe can be superfinished. Special heads can also be made for boring mills, grinders, and other machinery.

The superfinishing heads have a wide range of uses. They have been used for all sorts of work from the superfinishing of hairpin rolls to crankshaft bearings on large marine Diesel engine crankshafts several feet in length. ..... 54

## Flame Descaling Apparatus

The Air Reduction Sales Co., 60 E. 42nd St., New York City, has recently developed an oxy-acetylene descaling apparatus for removing scale or similar accumulations from iron and steel by rapidly heating the deposits with multi-flame tips. This heating causes the scale to crack off as a result of the difference in the rate of expansion between the scale and the base metal. The process is adapted for removing scale from ingots, billets, and slabs to expose seams and defects for inspection prior to scarfing or chipping. It can also be used for removing scale from forgings and steel castings prior to machining, as well as from steel castings after annealing. When necessary, the apparatus can be mounted on wheel-equipped carriages to facilitate traversing it across large steel surfaces.

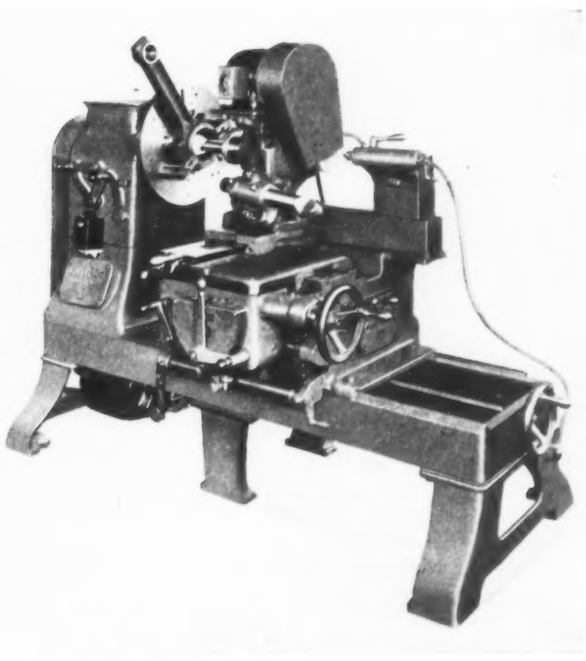
A secondary but equally important function of the apparatus is the driving out of the occluded moisture from within and beneath the surface scale of structural steel and plate by rapidly heating the surface with the high-temperature flames, leaving a warmed surface for painting. Immediately after the flame application, the surface is wire-brushed and swept clean of loosened scale particles and dust. The painting is then done before recondensation of moisture occurs. An ideal paint base is thus provided and the danger of further loosening of the protective mill-scale through weathering is minimized. ..... 55

## Lempco Turning and Grinding Machine

A grinding machine with a turret head that can be quickly swiveled from the grinding to the turning position has been placed on the market by Lempco Products, Inc., Bedford, Ohio. This machine, known as the Lempco "Du-All," has a 50-inch swing and can be used for general internal, external, and face grinding and turning work. The standard length of the bed is 6 feet, but beds of any length can be supplied. With the 6-foot bed, the distance between work centers is 44 inches.

A 2-H.P. motor of special design drives the precision type spindle by V-belts. The spindle runs in super-precision type ball bearings, mounted in matched preloaded pairs at both ends of the grinder quill. A quick-change lever provides four spindle speeds and three feed ratios. The coolant system is arranged to operate properly regardless of the direction in which the reversible drive is operating. The turret head, containing the cutting tool and grinding wheel, is mounted on the cross-slide and swivels in a diagonal plane. ..... 56

Removing Scale from Steel Surfaces with Oxy-acetylene Apparatus Developed by the Air Reduction Sales Co.



Lempco 50-inch Swing Machine with Turret that can be Quickly Swiveled into Position for Grinding or Turning

To obtain additional information on equipment described on this page, see lower part of page 806.

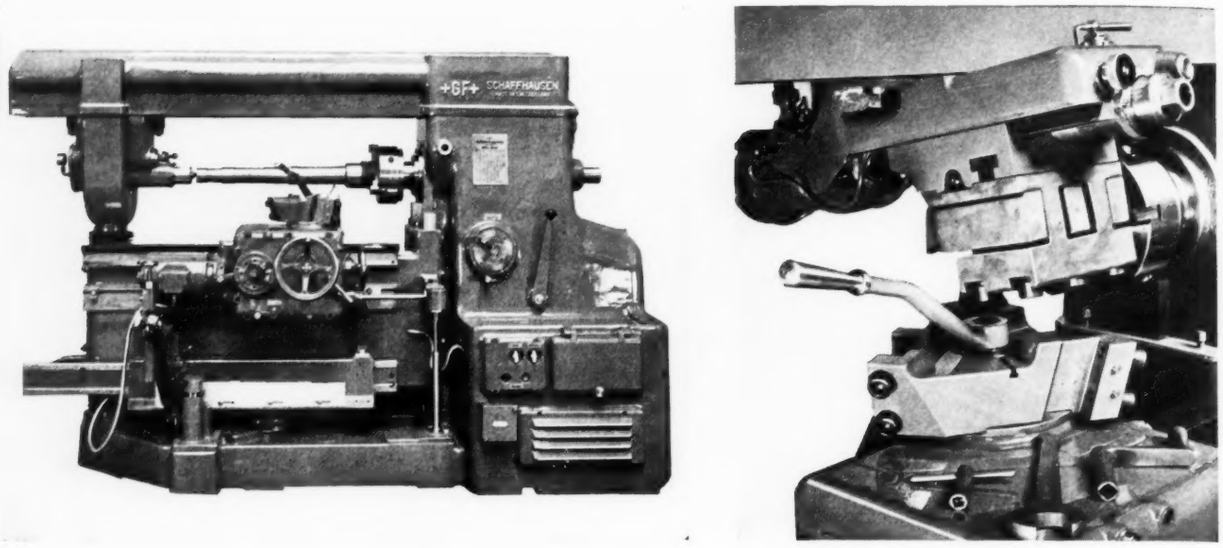


Fig. 1. (Left) Fischer Hydraulic Contour Duplicating Lathe Adapted for Turning Shafts Having Tapered and Shouldered Sections. Fig. 2 (Right) Close-up View of Tool-holder and Hydraulically Operated In-feed Fixture

## Contour Duplicating Lathe with Hydraulic Mechanism

A lathe designed on a new principle, for copying or duplicating medium and heavy work with varying diameters, shoulders, tapers and contours, is manufactured by the Fischer Steel Works, Schaffhausen, Switzerland, and sold by W. A. Schuyler, 250 W. 57th St., New York City. This lathe is especially adapted for machining alloy-steel parts such as shafts for machine tools, motors, gears, pumps, fans, etc. The base, column, over-arm, and outside cylindrical support of the lathe form a closed frame within which the tool-holder and work are rigidly held, as shown in Fig. 1. This construction enables cemented-carbide tools to be used to full advantage.

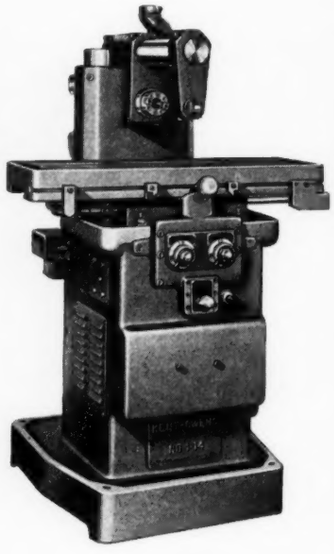
For contour duplicating, a templet of mild steel sheet material, of the same size and contour as the finished piece, is attached to the lower part of the lathe. A sensitive tracer follows the contour of the templet and actuates the hydraulic mechanism, which, in turn, automatically raises or lowers the knee carrying the tool. Thus the tool need be set by the handwheel for one diameter of the first piece of work only, the other diameters or contours then being machined automatically to correspond with the contour of the templet.

One of the unusual features of the lathe is that the tool, mounted in a turret head, is placed directly below the work with its top side facing the rear of the machine. The spindle and work turn in a direction opposite to the direction of rotation in the conventional lathe, so that the chips fall to the rear of the sloping side of the knee.

Fig. 2 shows the turret type tool-holder which accommodates three tools. Directly above the tool-holder is a hydraulically operated in-feed fixture which is attached to the over-arm. This fixture is fully automatic and is especially adapted for such work as squaring shoulders and necking. Eight spindle speeds ranging from 70 to 1200 R.P.M. are available, and sixteen longitudinal feeds ranging from 13/16 inch to 20 1/2 inches per minute can be obtained while the machine is in operation. The machine takes work up to 11 3/4 inches in diameter, and has a maximum distance between centers of 39 3/8 inches. ..... 57

## Kent-Owens Hydraulic Milling Machines

Two new hydraulic milling machines of chatter-proof design have been brought out by the Kent-Owens Machine Co., Toledo, Ohio. The heads of these machines are mounted on two cylindrical, accurately ground steel posts, with the spindle positioned midway between the posts. With this design, overhang and the possibility of a cocking action are eliminated. These high-speed milling machines are intended primarily for production work, but short runs can also be handled economically on them.



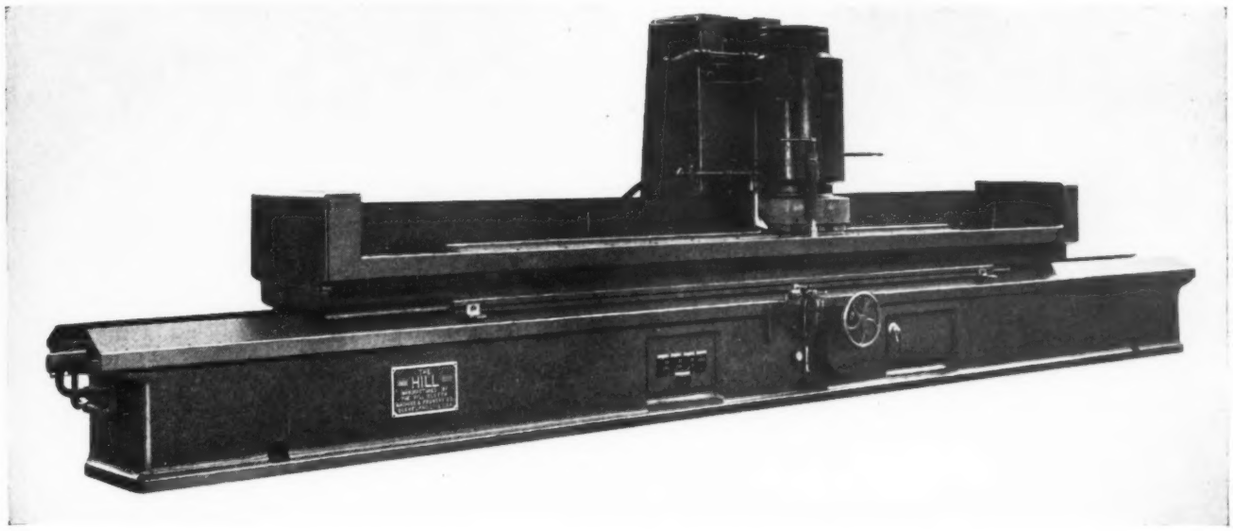
Hydraulic Milling Machine with Head Mounted on Two Steel Posts

The hydraulic feed for all table movements operates smoothly, without chatter or vibration. The control panel and hydraulic pump are standard commercial units, the pump being driven by a separate motor. The drive to the main spindle has only two gear contacts between the motor and the cutter. One of these is a pair of pick-off gears, which provides a range of spindle speeds from 100 to 1335 R.P.M. or 150 to 2000 R.P.M. The spindle is driven by a standard 1-H.P. motor.

All table movements are obtained by means of a control lever. Two graduated dials provide any feed rate from 1/2 inch to 80 inches per



To obtain additional information on equipment described on this page, see lower part of page 806.



Hill Vertical-spindle Heavy-duty Hydraulic Surface Grinder

minute. Dogs on the front of the table can be set to obtain the particular stroke and table cycle desired. Cross movement is obtained by means of a quill which has an adjustment of 2 1/2 inches. The head can be mounted vertically to give a maximum distance of 8 inches from the table to the center line of the spindle.

The No. 1-14 machine illustrated has a table travel of 14 inches. The table is 32 by 9 inches, has three T-slots. It can be fed or traversed rapidly in either direction and automatically reversed at both ends of the stroke or stopped at any point in its travel. The machine can also be equipped with either one-way or two-way positive stops for accurate depth milling.

The No. 1-8 machine has a table travel of 8 inches, and a table 25 by 9 inches, with three T-slots. The table can be traversed rapidly in both directions, fed in one direction only, automatically shifted from rapid traverse to feed, automatically reversed at the end of the stroke, and automatically stopped at the other end. Double-end automatic reverse can also be provided if desired.

This machine is ordinarily used with a simple automatic cycle, the operator engaging the starting lever manually to begin each cycle. However, when equipped with a double-end automatic reverse, the machine can be made to go through the simple cycle continuously. It can also be equipped with a positive stop for depth milling.

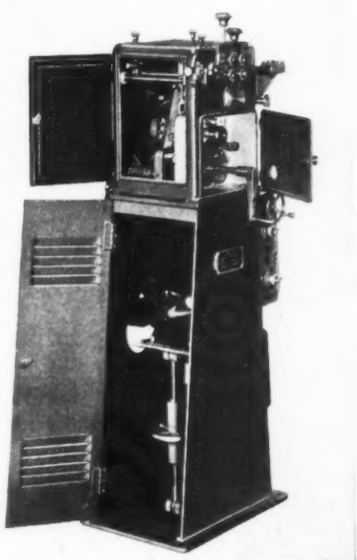
The coolant tanks are cast in the base, with an opening for draining. The intake and delivery passages are self-contained in the machine.....58

## Hill Vertical-Spindle Open-Side Hydraulic Surface Grinder

The Hill Clutch Machine & Foundry Co., 6400 Breakwater Ave., Cleveland, Ohio, has added to its line of heavy-duty hydraulic surface grinders a new 18- by 168-inch vertical-spindle open-side type machine with a dynamically balanced built-in motor. The vertical spindle carries a segmental grinding wheel 26 inches in diameter. The machine is built with tables 18 or 24 inches wide, and from 6 to 20 feet long.....59

## Sleeper & Hartley Improved Segment Type Spring Coiling Machine

Two hundred coil springs can be made per minute from wire 0.004 to 0.028 inch in diameter on the improved No. 0 universal segment type spring coiling machine recently brought out by Sleeper & Hartley, Inc., Worcester, Mass. This 24-inch model Series 668 machine, with standard equipment, will coil and cut all kinds of compression and extension springs from any size wire within its range and with inside diameters from 1/32 to 11/32 inch.



Sleeper & Hartley Improved Segment Type Spring Coiling Machine

The standard wire feed is 24 inches, but can be increased to 36 inches on sizes up to 0.02 inch through the use of special auxiliary gearing. Improvements in this new machine include a one-piece cast-iron housing designed for rigid and accurate alignment; ball bearing construction throughout on all rotating shafts; rapid and micrometer adjustment of compound blocks, which facilitates set-up time.

The pitch and diameter cam controls are readily accessible for adjustment. The cams can be shaped, timed, and attached to the cam hub, which can be removed from the shaft as a unit without losing the "time" setting. One-piece solid cams can be used on the removable cam hub. This coiling machine can be obtained with three types of drive—motor and variable-speed transmission drive; variable-speed motor pulley drive;

To obtain additional information on equipment described on this page, see lower part of page 806.

and pulley drive with a flanged pulley and clutch. A 1/2-H.P. motor operating at a speed of 1800 R.P.M. is recommended for use with this machine. The weight of the machine is 575 pounds. ..... 60

## Newton Unit-Head Planer Type Milling Machine

A straight line production milling machine for milling operations on Diesel engine frames and bases, was built recently by the Newton Division of the Consolidated Machine Tool Corporation, Rochester, N. Y. The unit-head box type construction of this machine, as shown in the accompanying illustration, adapts it for handling a number of different parts, yet it has the accuracy, ruggedness and speed ordinarily found only in a single-purpose machine.

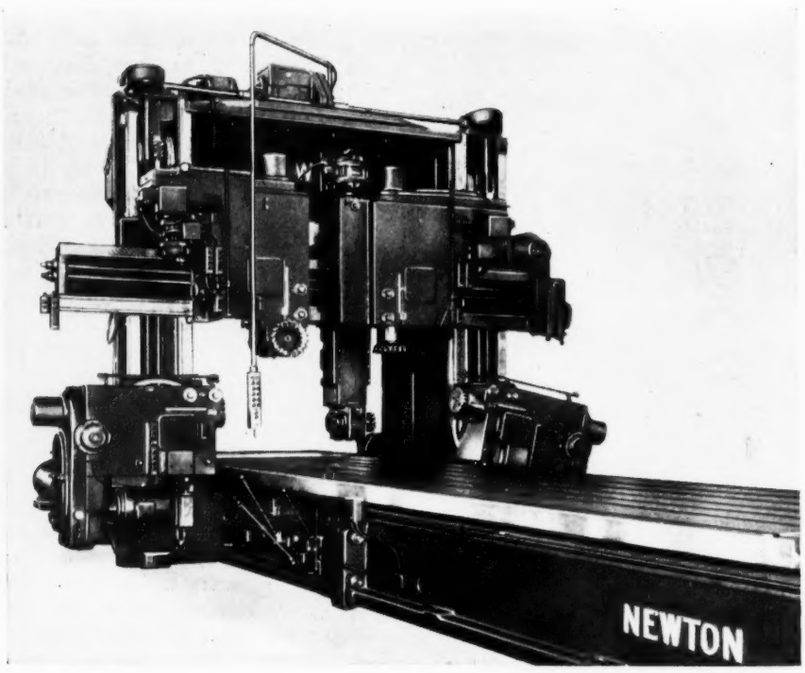
The two horizontal milling heads mounted on the uprights are of the swiveling type and are adjustable through a wide arc either side of the center. The two vertical unit heads mounted on the cross-rail are non-swiveling and so constructed that the extension center head can be bolted to either one of them and to the cross-rail. A series of bolt holes in this center head permits mounting it in a wide range of positions vertically, thus keeping the overhang at a minimum.

The versatility of this machine is increased by the right-angle milling attachment shown mounted on the left-hand vertical head. With this attachment in the position shown, the ends of frames can be milled without disturbing the set-up. Vertical movement is obtained from the cross-rail.

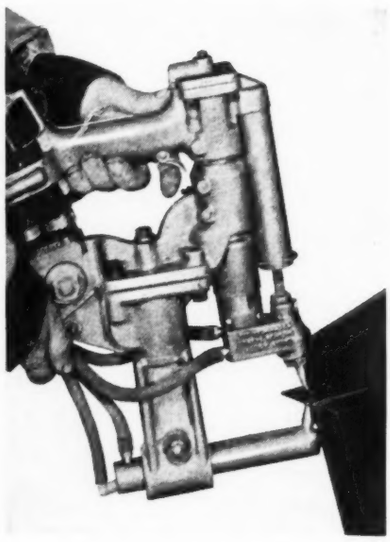
Feed and power rapid traverse are provided for each head and for the cross-rail through motors connected to gear-boxes. Table feed is obtained from the motor through a gear-box, a clutch being employed for selecting either the rapid traverse or feed.

Graduated scales, dial indicators and pointers facilitate setting up the work and adjusting the cutters. Push-button control is used with dual control on each side of the machine wherever practical. Pendent switches control the table feed and traverse and the rail head feed and traverse.

Safety devices for preventing damage to the machine include limit switches, interlocks that stop the feed motors before the spindle motors stop, and an arrangement for stopping the feed and traverse motors should the lubrication to the table stop or fail for any reason. A total of seventeen motors ranging from fractional horsepower up to 15 H.P. sizes is required to operate this machine. ..... 61




Newton Planer Type Milling Machine Built for Milling the Frames and Bases of Diesel Engines



"Pincher" Type Light-weight Welding Gun Made by Progressive Welder Co.

## Light-Weight Welding Gun

The Progressive Welder Co., 737 Piquette Ave., Detroit, Mich., has recently brought out a "pincher" type welding gun of extremely light weight. This welding gun is hydraulically operated, and is designed for welding currents up to 50 kilovolt-amperes and welding pressures up to 1000 pounds. Built almost entirely of magnesium, it can be easily manipulated with one hand. The light weight reduces operator fatigue, speeds up production, and improves welding efficiency. The gun is adapted for making spot-welds in regular production work where one gun is used in many positions.

Current is transmitted to the electrodes directly through the pressure cylinder and piston. The gun is cooled by two water circuits. One stream of water is circulated through the sliding contact head to one electrode, while the other cools the lower electrode and its welding point. The gun is available in C-type, scissors, yoke, and in a great variety of special types. ..... 62

## Atkins Hacksaws

E. C. Atkins & Co., 402 S. Illinois St., Indianapolis, Ind., have added to their Silver Steel line of hacksaw blades two new blades designated Nos. 400 and 500. The teeth of these new blades are shaped to produce coiled shavings that have the appearance of clock springs. The coiling action causes the chips to eject themselves freely from the gullets of the teeth. ..... 63

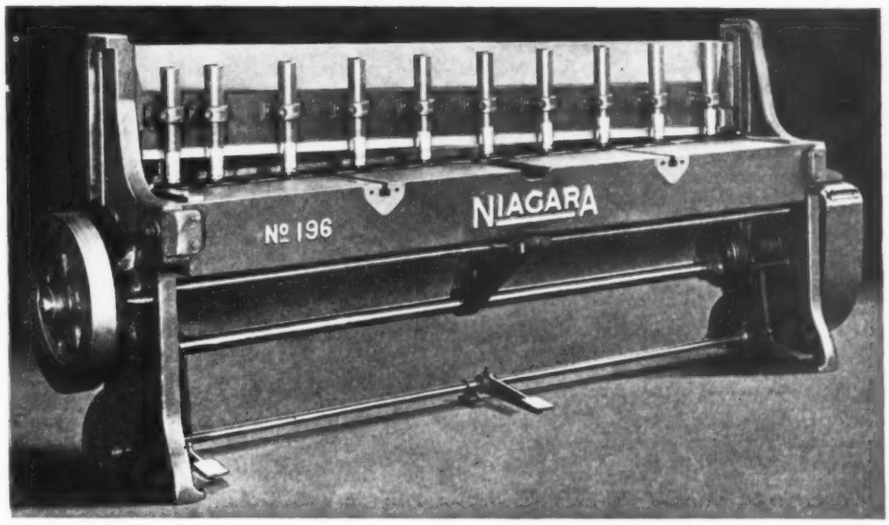


To obtain additional information on equipment described on this page, see lower part of page 806.

## Niagara Power Squaring Shears

Several improvements have been made recently in the Series 100, 10, and 500 power squaring shears built by the Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y. The 100 series shears are now provided with the new type self-measuring parallel back gage as standard equipment. This universal type, ball-bearing back gage is used on shears with cutting length of 96 inches and longer. It has a range of 18 inches and measures with micrometer accuracy, each turn of the handwheel being equal to 1/4 inch of gage-bar travel. The handwheel has a dial that indicates the gage position to the nearest 1/64 inch. There is also a spring-pin locking device having locking holes for each 1/128 inch of gage-bar travel.

These shears are also furnished with the new type triangular section cross-head and the new type hold-down with individual spring pressure feet that provide uniform holding pressure, regardless of metal thickness or length of sheet. ..... 64

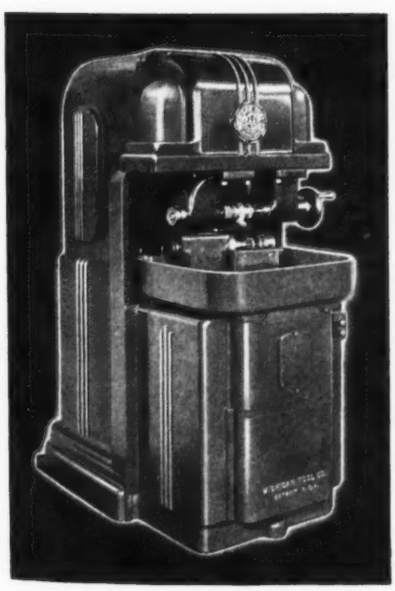



Niagara No. 196 Power Squaring Shear with Nominal Cutting Length of 96 Inches

## Improved Michigan Rotary Gear Finisher

The 860 rotary gear finisher made by the Michigan Tool Co., 7171 E. McNichols Road, Detroit, Mich., is now being built with an entirely new drive and various improvements designed to give the product greater accuracy and a finer finish. The two sets of "cone" worm-gears in the new drive have eliminated ten gears used in the previous drive and improved the smooth running qualities to such a degree that the machine is practically noiseless in operation. The power required to drive the machine has also been cut in half by the higher efficiency of the new drive, even though the power for driving the coolant pump is now furnished by the main motor.

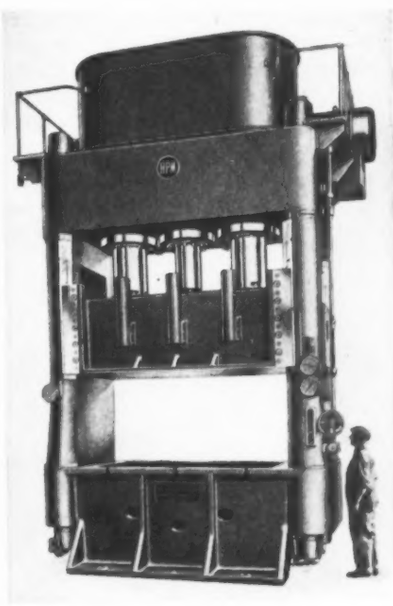
Other improvements in the machine, include provision for an indicator attachment, which permits rapid resetting of the machine for finishing the various sizes and types of gears; a 4 to 1 ratio lifting mechanism for raising the work-spindle to the proper position relative to the cutter-spindle after loading, and for dropping the table for unloading; complete enclosure of the lubricating system; use of high-pressure fittings that are easily accessible; and precision ball-bearing construction throughout. ..... 65



Michigan Rotary Gear Finisher with Improved Drive

## "Fastraverse" Double-Action Drawing Press

A self-contained hydraulic "Fastraverse" double-action press has recently been built by the Hydraulic Press Mfg. Co., Mount Gilead, Ohio, which offers a dual range of working pressures and speeds for sheet-metal drawing operations on large work. There are two separate pressing members—the main slide and the die cushion slide. The main slide is actuated by three main rams located in the press head. All three rams are employed when heavy pressure service up to 1000 tons is required. For lighter work, only the central ram is used, faster action under load being obtained in this case. The change-over from three-ram to one-ram operation is accomplished by means of a selector valve. By applying the hydro-power closed circuit operating system with its "valveless" connection between two hydro-power reversible variable delivery pumps and the main cylinders, fast yet shockless reversal is obtained.



"Fastraverse" Drawing Press for Pressures from 100 to 1000 Tons

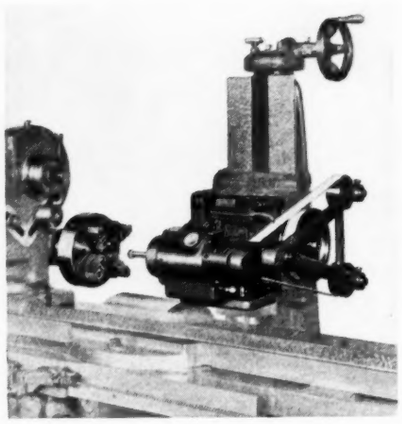
To obtain additional information on equipment described on this page, see lower part of page 806.

The second pressing member—the die cushion slide—is located within the press bed. No additional power equipment is required for operating this slide, as the second pressing action is obtained through working pressure received from the press operating system. The pressure of the die cushion can be adjusted to meet requirements. ..... 66

## Glyptal Gray for Preventing Adhesion of Weld Spatter and Corrosion

The General Electric Co., Schenectady, N. Y., has recently added to its line of welding accessories a material known as "Glyptal 1294 Gray." When applied to metal that is to be lap-welded, this material prevents corrosion at the joint where the plates overlap and also prevents adhesion of the welding spatter. It is applied by spraying or brushing.

Materials coated with Glyptal Gray at the mill can be exposed to the weather until fabrication is completed without requiring further cleaning. It not only serves to prevent corrosion of lap welds, but also provides a good base for paint. ..... 67



Internal Grinding Attachment for B & S Tool Grinding Machines

## Brown & Sharpe Internal Grinding Attachment

The Brown & Sharpe Mfg. Co., Providence, R. I., has developed a ball-bearing internal grinding attachment for use with the B & S No. 13 universal and tool grinding machines. This attachment is designed for the rapid and accurate grinding of holes ranging in size from a minimum diameter of 1/4 inch and a maximum length of 1 inch up to a minimum diameter of 7/16 inch and a maximum length of 2 inches.

The tapered cartridge type spindle unit is carried in a body casting mounted on a knee secured to the front of the wheel-slide of the machine. The grinding spindle, driven from the machine spindle by a canvas belt, runs at a speed of 27,000 R.P.M., and is supported by two double-row self-aligning ball bearings.

The spindle lubricating oil is filtered before it reaches the bearings and after it has passed them, being caught in a tray which can be easily removed. The wheel-arbors are interchangeable, and each is seated by a taper and held in the spindle by its threaded end. A four-jaw chuck with jaws that are independent and reversible is furnished with the attachment.

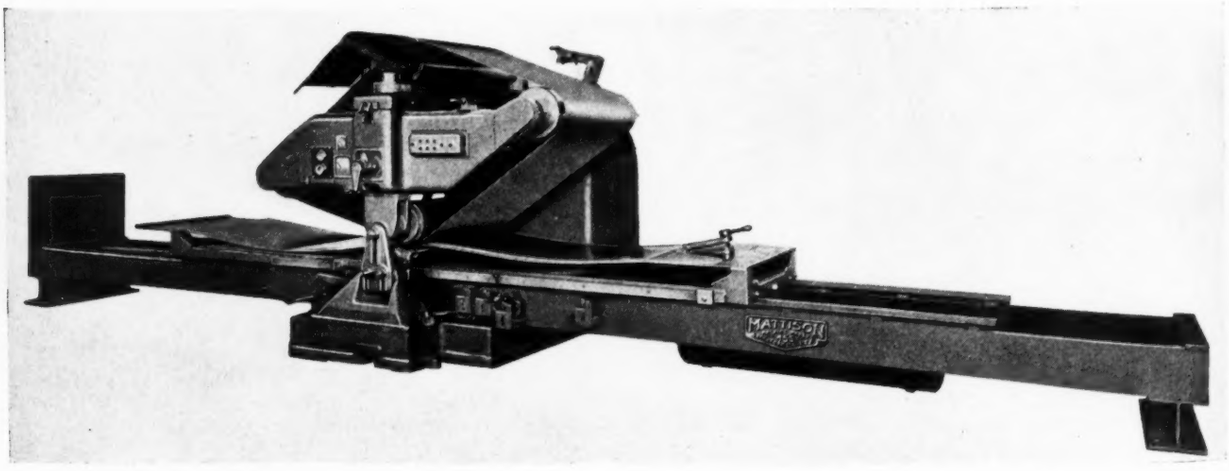
A No. 0A change-gear guard for completely enclosing the gearing that drives the headstock of the universal spiral index-centers used on B & S No. 0 Omniversal milling machines has also been brought out by the company. This guard can be quickly placed in position or removed from the machine, being attached to the table by two screws.

The full set of change-gears fur-

## Mattison Wide-Belt Sheet Grinding and Polishing Machine

The Mattison Machine Works, Rockford, Ill., are now building a No. 455 wide-belt sheet grinding and polishing machine that is especially designed for the proper application of factory-coated abrasive belts to the grinding of stainless steel and other alloy sheets. The precision with which this machine has been built and its weight make it well adapted for the production of smooth surfaces. It has also been designed with the object of obtaining the highest efficiency and longest life from factory-coated abrasive belts used for the grinding operations.

The machine permits the quick application of the abrasive belts, which are automatically controlled and oscillated on the rolls. Push-button stations and controls for the tables are located at the front of the machine. Contact rolls are removable, and rolls having any degree of cushioning effect can be easily interchanged to suit the type of work handled. The machine can be furnished in various widths and lengths, and is built to carry belts up to 40 or 50 inches wide, processing sheets up to 36 or 48 inches wide, and 10, 12, and 14 feet long. ..... 68




Mattison Abrasive Belt Grinding and Polishing Machine



To obtain additional information on equipment described on this page, see lower part of page 806.

nished with the machine can be used, the horizontal cover swinging open to facilitate changing gears. A hand-crank inserted through a hole in the guard permits hand adjustment of the headstock, the guard being closed after the gears are set up. ..... 69

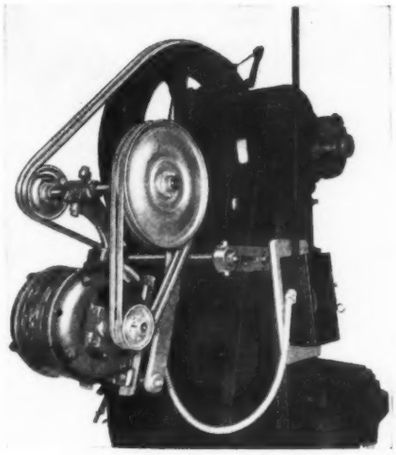
## New Oakite Composition for Improved Electro Cleaning

A new material has been developed by Oakite Products, Inc., 14 Thames St., New York City, known as Composition No. 54, for removing all types of oil and dirt accumulated on steel during fabrication prior to electroplating. An improved electro cleaning method that makes practical thorough removal of polishing compounds from polished steel in one operation before plating, has been made possible through the development of this new cleaning compound.

Among the improvements claimed for this new compound are increased speed of the cleaning cycle; brighter electroplate; improved plating coverage of intricately shaped articles; complete utilization of all throwing power in the plating bath; elimination of pits and pores in the deposited metal; and improved corrosion resistance. ..... 70

## Individual Motor Drive Units for Machine Tools

The individual punch press drive here illustrated was brought out recently by the Quality Hardware and Machine Corporation, 5853 N. Ravenswood Ave., Chicago, Ill. Punch presses and similar types of machine tools can be converted to individual motor drive with this equipment, using standard motors having speeds of 1750 to 1800 R.P.M. Any desired operating speed in the usual range



Motor Drive Unit Applied to Punch Press

can be obtained by speed reduction through the V-belt and sheave drives. The final driving belt runs directly on the press flywheel, which requires no alteration or grooving.

The drive consists essentially of a frame mounted on a central shaft which is held in brackets on the press. This frame carries the motor base and the drive arm on which the final drive-shaft is mounted. The construction is such that proper belt tension is easily maintained by utilizing the weight of the motor. The entire assembly pivots around the central shaft, automatically providing proper belt tension for the final drive. The driving belts can be tightened or loosened by simply adjusting the motor on its base. ..... 71

## Barco Revolving Type Flexible Ball Joints

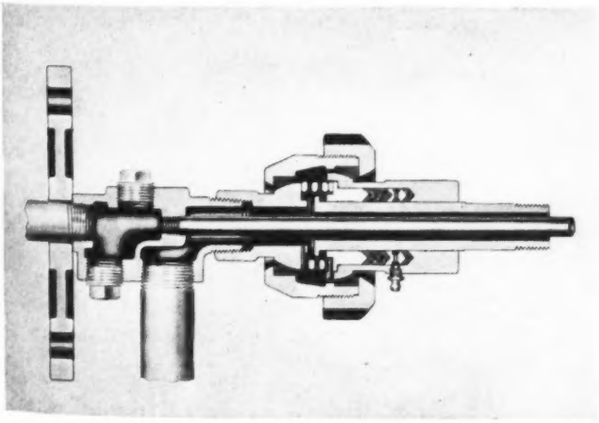
The Barco Mfg. Co., 1801-1815 Winnemac Ave., Chicago, Ill., has brought out a new line of revolving joints for use in supplying steam, gas, or other fluids from a fixed or stationary pipe to a rotating drum or other member without leakage. The sleeve of this joint is the only revolving member. This sleeve also slides out and in, taking care of any end play in the revolving drum.

The double ball design provides the flexibility necessary to compensate for any slight misalignment or eccentricity of movement. An adapter is available which permits two different fluids to be fed into the revolving drum or condensate to be syphoned out through the same opening. The adapters are made in various styles for standard pipe threads ranging from 1/2 inch up to 1 1/2 inches. ..... 72

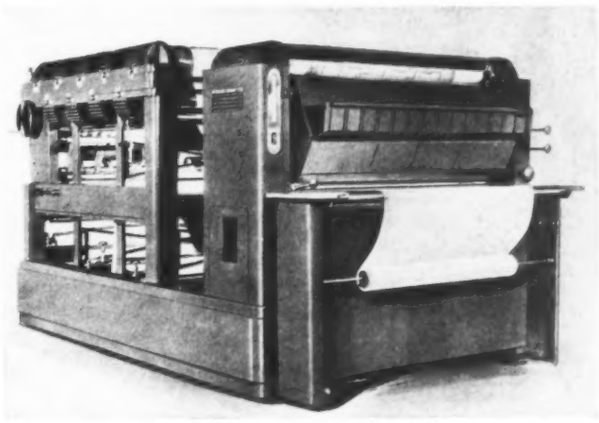
## Pease Blueprinting, Washing, and Drying Machine

The C. F. Pease Co., 2601 W. Irving Park Road, Chicago, Ill., has brought out a new continuous blueprinting, washing, and drying machine designed for rapid performance. This Model 22 machine utilizes the company's patented actinic arc lamps, which are now controlled through a new patented switch arrangement that permits the lamps to operate at any one of three speeds.

The new washer comprises three horizontal water tanks on which the paper floats as it is washed, thus eliminating tension wrinkles and distortion. Nine aluminum drums are used to dry the paper evenly and flat, at a considerable saving in gas or electricity. Potash and hypo applications are easily and quickly interchanged by a simple lever control. A production rate of 24 linear feet per minute on direct current, or 18 linear feet per minute on alternating current, is available for large tracings. ..... 73

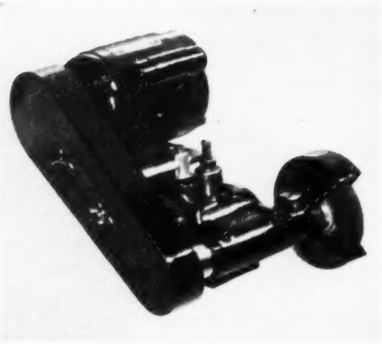


Barco Revolving Flexible Ball Joint with Syphon Adapter



Pease Continuous Blueprinting Machine

To obtain additional information on equipment described on this page, see lower part of page 806.



Dumore Grinder Adapted for External and Heavy Internal Grinding

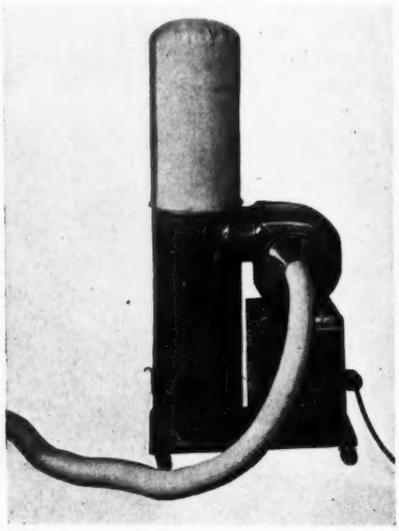
## Dumore Grinder Adapted for Production Work

The new No. 77 grinder recently brought out by the Dumore Co., Racine, Wis., is recommended for use where most of the work is external or heavy internal grinding. It has a 1/2-H.P. capacitor starting induction motor or a constant-speed alternating-current motor, and will operate efficiently on production work.

The tension on the belts of the V-belt drive is adjusted by sliding the motor base and tightening four cap-screws. A complete set of interchangeable sheaves or pulleys provides speeds from 3810 to 7650 R.P.M. for driving wheels from 3 to 6 inches in diameter.....74

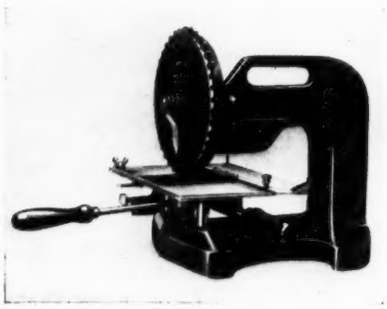
## Covel Dust Collectors

A self-contained, motor-driven unit, which is designed to collect the dust directly from the grinding wheel of a machine, has been brought out by the Covel Mfg. Co., Benton Harbor, Mich. A cyclone separator and a canvas bag arrangement act as a double check in removing the fine dust particles before the cleaned air re-enters the room.



Covel Dust Collector for Grinding and Metal-cutting Machines

The unit can be mounted permanently on the floor or above the machine, or it can be mounted on casters to facilitate its movement about the shop. It can be equipped with ducts for collecting the dust from the wheels of two machines, when desired. The unit is made in two models, one having a 1/3-H.P. motor with a capacity of 150 cubic feet of air per minute at a 2-inch vacuum, while the other is equipped with a 1-H.P. motor and has a capacity of 235 cubic feet of air per minute at a 4-inch vacuum.....75



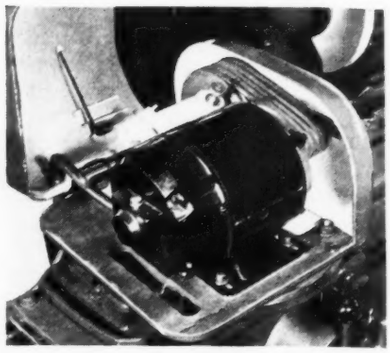
Nameplate Stamping Machine Made by H. O. Bates

## Nameplate Stamping Machine

A deep-throat nameplate stamping machine, designed to handle large-size nameplates, has been developed by H. O. Bates, 251-257 N. Broad St., Elizabeth, N. J. This new machine is similar to the one described in March, 1938, MACHINERY, page 478, except for the throat depth, which has been increased to 8 inches.

The vertical adjustment makes it possible to mark plates of any thickness up to 1/2 inch. The machine will mark nameplates within a space of 4 1/2 by 6 inches, but nameplates 8 by 8 inches can be held on the standard table. The table can be especially constructed, however, for marking nameplates of any length. Scale beams and other metal strips can also be numbered.

Although adapted for a variety of work, this machine will mark very small plates rapidly and accurately. The standard No. 2 machine is furnished with interchangeable and replaceable dies in any size from 1/16 to 3/16 inch.....76



Landis Universal Grinder Headstock with Cover up to Show Spindle Drive

## Landis Universal Grinder Headstock

The new headstock now being supplied with all hydraulic universal grinders made by the Landis Tool Co., Waynesboro, Pa., is of unusually compact and simple design. Its smooth modern lines make it attractive and easy to keep clean. It is driven by an adjustable-speed motor that can be operated on either alternating or direct current. The motor is started and stopped by means of the work and traverse start-and-stop lever. Power is transmitted from the motor directly to the spindle by multiple V-belts. An infinite number of work speeds is obtainable, the speed ratio never being less than 6 to 1 and on some sizes as high as 12 to 1.

The speeds are selected by means of a dial having large, easily read figures. The spindle and faceplate are mounted in ball bearings of the super-precision type in order to obtain low power consumption and lessen the amount of faceplate overhang. A convenient plunger arrangement makes it possible to change the spindle quickly for either "live" or "dead" operation. The spindle nose is the American Standard Type A-2.

Provision is made for locking the faceplate to facilitate the mounting of chucks and similar work-holding equipment. The headstock is graduated and can be swiveled 90 degrees on its base for face grinding. Dynamic braking is utilized to stop work rotation. The lifting of one large cover at the front exposes the motor, drive, and spindle.....77

## McKay Stainless Electrodes

A complete line of stainless steel electrodes developed to meet the chemical analysis requirements for stainless steel welding is being



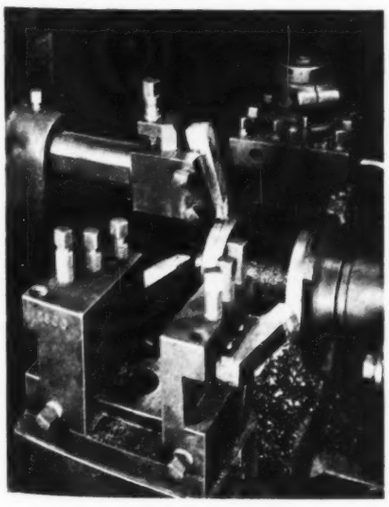
To obtain additional information on equipment described on this page, see lower part of page 806.

placed on the market by the McKay Co., Pittsburgh, Pa. These electrodes, known as the "McKay Certified Stainless Electrodes," are put up in packages containing a certification of the weld deposit analysis obtained by their use instead of the analysis of the wire itself.....78

## Rexalloy Tool Bits

A cast non-ferrous cutting alloy, known as Rexalloy, which has as its basic elements cobalt, chromium, and tungsten, has been brought out by the Crucible Steel Co. of America, 405 Lexington Ave., New York City. This material has such a high degree of hardness at elevated temperatures that it is practically unforgeable. The hardness and structural stability at high temperatures are indicated by the fact that only a one point drop in hardness on the Rockwell C scale results from exposure to a heat of 2000 degrees F.

Tool bits of this material can be ground readily with ordinary toolroom equipment. Either wet or dry grinding may be employed, but excessive heating and pressure must be avoided. The recommended cutting speeds range from 150 feet per minute for cast iron, with a feed of 0.125 inch, up to 300 feet per minute for copper, with a feed of 0.030 inch. These tool bits are made in seven standard sizes ranging from 1/4 inch square by 2 1/8 inches long up to 3/4 inch square by 5 inches long. The bit shown in the illustration finishes 25 pieces per grind operating at a speed of 270 feet per minute, taking a 1/4-inch cut with a feed of 0.010 inch.....79

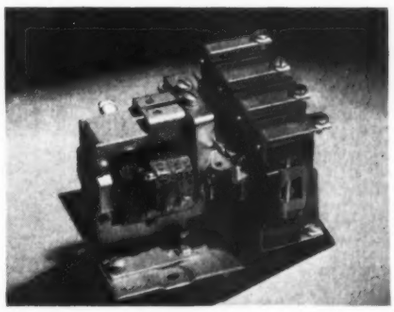


Rexalloy Tool Bit Turning Hard Gray Iron Casting 8 Inches in Diameter

## Westinghouse Contactors for Machine Tool Controls

A line of multi-pole contactors for machine tool and other built-in control applications has been placed on the market by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The relays are rated at 10 amperes, 500 volts maximum capacity, and are available in two- to eight-pole forms in any combination of normally opened or closed contacts. In addition to individual relays, there are assemblies of two relays which are mechanically interlocked. Latched-in contactors or relays have also been developed.

A new feature, intended to prevent mistakes, is the identification labels which show the voltage and current frequency rather than the

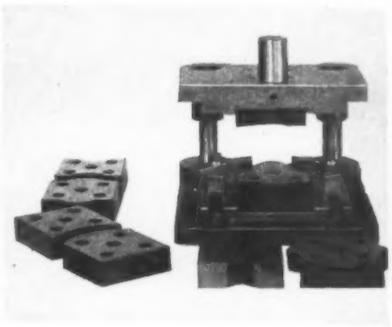


Westinghouse Four-pole Unit Contactor for Machine Tool Control

usual identifying number. These relays are arranged for front wiring, and are assembled as complete units on steel bases suitable for mounting on insulating or steel panels as a part of the controller. Positive drop-out and adequate pressure on the normally closed contacts are obtained by the use of heavy kick-out springs, in addition to the normal contact springs and gravity action. All terminals in this Type Dn-00 contactor are easily accessible.....80

## Utility Corner Radius Trimming Die

A die designed for trimming the sharp corners of square-sheared sheet-metal blanks to provide round corners of the radius desired has been added to the line of dies manufactured by the Service Machine Co., 162 Miller St., Elizabeth, N. J. Interchangeable trimming blocks in pairs, consisting of the upper and lower die members, are located by a pilot or large dowel at the center of the die-block, so that no fitting or



Corner Radius Trimming Die with Interchangeable Trimming Blocks

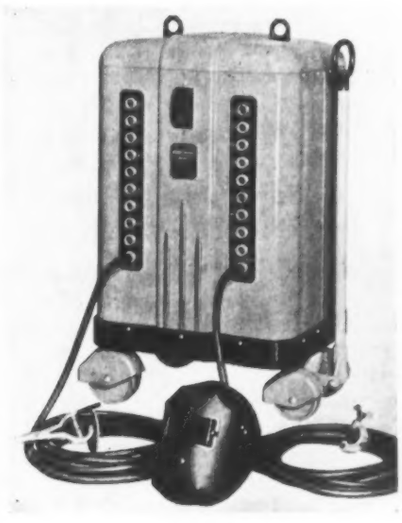
adjustment is necessary when the die is being set up.

The smaller radii are cut on four-way die-blocks, which can be turned 90 degrees for cutting a different size radius. The upper and lower blocks can be interchanged for cutting 90-degree radius shaped corner notches. Blocks for cutting corners or notches of special shape can also be made to fit the die set.

The regular radius blocks include 1/4-, 3/8-, 1/2-, and 5/8-inch radii on a four-way pair of blocks; and 3/4- and 7/8-, and 1- and 1 1/4-inch radii on two pairs of two-way blocks. Sizes for radii of 1 1/2 to 2 3/4 inches are made in pairs of single blocks. Other sizes or combinations of shapes can be made to order.....81

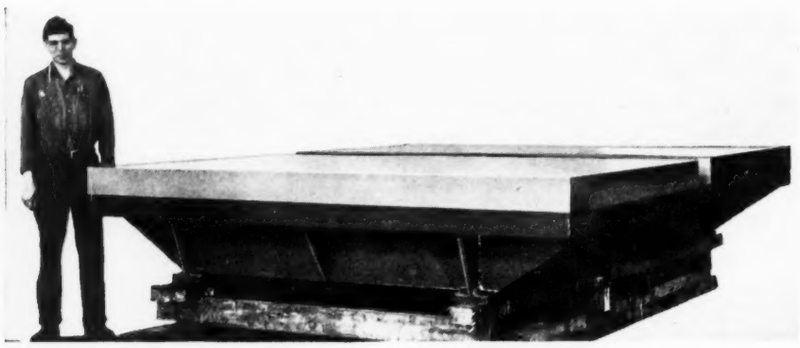
## Marquette Alternating-Current Arc Welders

The Marquette Mfg. Co., 409 N.E. Johnson St., Minneapolis, Minn., has added to its line of welding ma-



Alternating-current Arc Welder Made by the Marquette Mfg. Co.

To obtain additional information on equipment described on this page, see lower part of page 806.



Two 7-ton Surface Plates Made by the Goodman Mfg. Co.

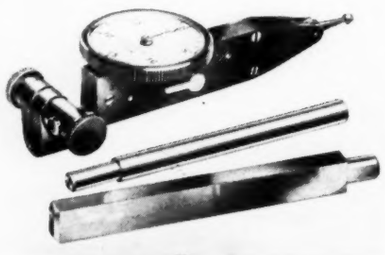
chines a 350-ampere Model 400-BT alternating-current arc welder, designed for continuous production. With the new addition, this line of welding machines now covers a range of sizes capable of welding material varying from thin sheet metal up to heavy beams.

The new welder has a range of from 30 to 350 amperes, with a separate tap for each of the nineteen heat stages. The amperage is plainly marked beside each tap. The transformers are designed to operate at full capacity continuously and to deliver a strong stable arc at any heat stage. The machine is now listed under the "Re-examination Service of Underwriters Laboratories, Inc."

Another addition to this company's line of alternating-current arc welders is the Model 300-BT machine, which is similar to the Model 300-B but is mounted on a new type of truck. This truck is especially designed for use where it is desirable to move the welder quickly from one place to another. The handle and pivot on the lead truck facilitate transportation about the shop or factory. The 300-BT machine is listed by Underwriters Laboratories, Inc., and has a range of from 20 to 250 amperes. The transformer is designed to give a steady even arc at all heat stages. ..... 82

## Goodman Large-Size Surface Plate

The Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill., has recently made several large-size surface plates. The accompanying illustration shows two of a lot of four surface plates shipped to one customer. The two plates shown, each 6 by 10 feet, are set up adjacent to each other to form a plane surface 10 feet by 12 feet which is true or accurate within plus or minus 0.0005 inch. Each surface plate consists of a single iron casting, in which the stresses have been relieved. Surface plates of this kind can be furnished with either an accurately machined or a hand-scraped surface. ..... 83



Brown & Sharpe Dial Attachment

## Brown & Sharpe Dial Attachments for Use with Vernier Height Gages

The Brown & Sharpe Mfg. Co., Providence, R. I., has recently added two dial gage attachments to its line of precision equipment. These small, compact gages have jeweled bearings and are designed for the sensitive testing of small slots and holes that are difficult to reach with the spindle of a regular dial gage. They can be readily used with a surface gage or height gage and as a special gaging fixture on a machine tool or testing device.

The No. 725 attachment illustrated is intended for use with vernier height gage No. 585 and surface gages Nos. 621 and 622 of this company's manufacture. The rod and bar shown below the gage can be gripped in the swivel clamp at the end of the gage case, the rod being used when the instrument is employed with the surface gages, while the bar is used with the height gage.

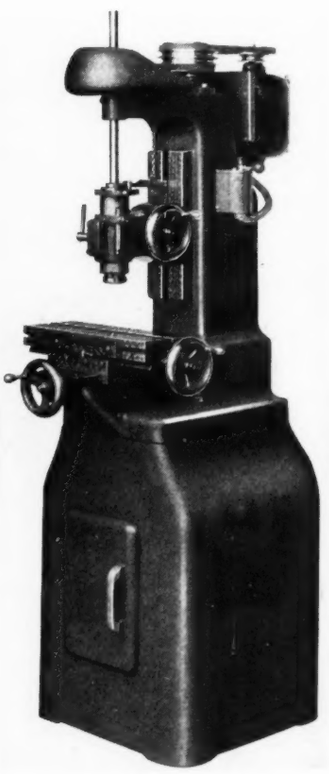
The No. 725-A attachment is for use with vernier height gage No. 585, and is similar to the one illustrated, except that the swivel clamp for attachment to the bar is fitted to a dovetail slide on the bottom of the gage case. This provides means for supporting the dial gage close to the work-contacting point. ..... 84

## Linley High-Speed Vertical Milling Machine and Jig Borer

The Linley Bros. Co., 14 Montauk St., Bridgeport, Conn., has brought out a new model high-speed vertical milling machine and jig borer equipped with a micrometer screw-feed quill. Direct-reading features eliminate the necessity for making calculations and thus prevent possible errors in performing jig boring operations. The screw-feed quill is designed to assure smooth, accurate boring to any predetermined depth up to 3 inches.

This new machine is made in floor and bench types. It is particularly adapted for use in tool-rooms, pattern shops, etc., being especially suitable for small work such as dies, jigs, fixtures, models, molds for plastics, metal patterns, and other types of work requiring laying out, drilling, milling or boring.

The machine is equipped with a table 5 1/2 by 14 1/2 inches in size, which has a longitudinal travel of



Linley Milling Machine and Jig Borer



To obtain additional information on equipment described on this page, see lower part of page 806.

10 inches and a crosswise travel of 5 inches. The maximum height from the top of the table to the end of the spindle is 9 inches. The sliding head has a movement of 8 inches, and the spindle has a travel of 3 inches. The distance from the center of the spindle to the column ways is 5 3/4 inches. The spindle speeds range from 275 to 4250 revolutions per minute. The collet capacity is 1/2 inch. ..... 85

## Van Dorn Electric Drills of Improved Design

Seven units in the line of electric tools made by the Van Dorn Electric Tool Co., Towson, Md., have been redesigned recently to reduce their weight, make them more compact, and give them greater durability. Particular attention is called to the new 1/2-inch Utility electric drill shown in Fig. 1, which is fully 3 1/8 inches shorter than the previous model, three pounds lighter in weight, and has improved operating balance. Its close-coupled construction, minimum spindle offset, and horizontally positioned spade handle are advantages, especially when the tool is used in restricted areas. This new drill has a universal motor which operates on either alternating or direct current.

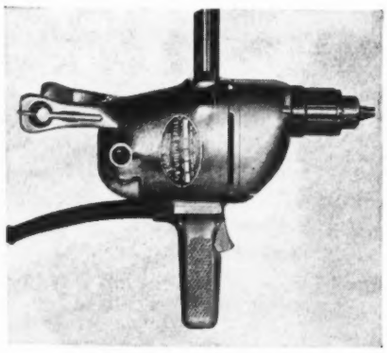


Fig. 1. Van Dorn 1/2-inch Standard Utility Electric Drill

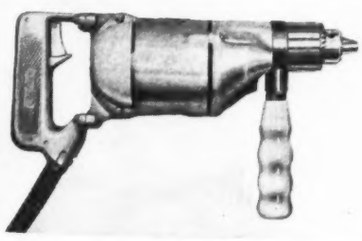


Fig. 2. Van Dorn 3/8-inch Utility Drill with Auxiliary Handle

The other redesigned units are the 3/8-inch heavy-duty, 3/8-inch Utility, 5/16-inch heavy-duty, and 1/4-inch heavy-duty electric drills. Two new drill stands, designated as Nos. 20 and 40, have also been developed by the company. ..... 86

## Sullivan Light-Weight Portable Compressors

The Sullivan Machinery Co., Michigan City, Ind., has just added to its line of air compressors a new portable machine known as the "Zeph-Air." Compact construction, self-starters, and refinements designed to facilitate transportation and ease of operation are features of these new machines. The compressors are made

Sullivan "Zeph-Air" Portable Compressor

in two sizes, with capacities of 60 and 85 cubic feet of air per minute, respectively. ..... 87

## "Stow Junior" Pedestal Type Flexible-Shaft Units

A new low-priced line of flexible-shaft tools for grinding, polishing, buffing, wire-brushing, sanding, filing, and drilling operations, that is designated the "Stow Junior," has been brought out by the Stow Mfg. Co., Inc., Binghamton, N. Y. The first of the new line is the pedestal type unit illustrated. This unit consists of a flexible shaft and clamp spindle, motor, and extension cord with plug for connection to any light socket.

The unit is mounted on a four-leg metal base with ball-bearing casters, and can be easily pushed around the shop. The pedestal is adjustable in height, maintains a low center of gravity even when in the extended position, and carries a convenient tool tray. The standard attachments used on the heavy-duty units made by the same company are recommended for use with the Junior units.

"Stow Junior" Pedestal Type Flexible-shaft Unit

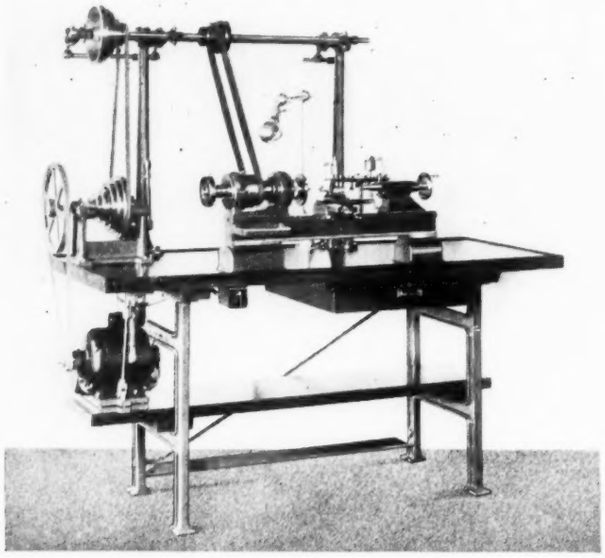
Motors of either 1/4, 1/3, or 1/2 H.P. can be obtained, with two choices of speed, namely, 1725 or 3450 R.P.M. The 1/4-H.P. tool has a 3/8-inch flexible shaft 5 feet long. It has a maximum wheel capacity of 4 inches by 1 inch and a maximum drilling capacity of 1/4 inch. The 1/3- and 1/2-H.P. tools have a 1/2-inch by 6-foot shaft, a maximum wheel capacity of 6 inches by 1 inch, and a maximum drilling capacity of 3/8 inch. ..... 88

## Ozalid Light-Sensitized Foil for Duplicating Drawings and Tracings

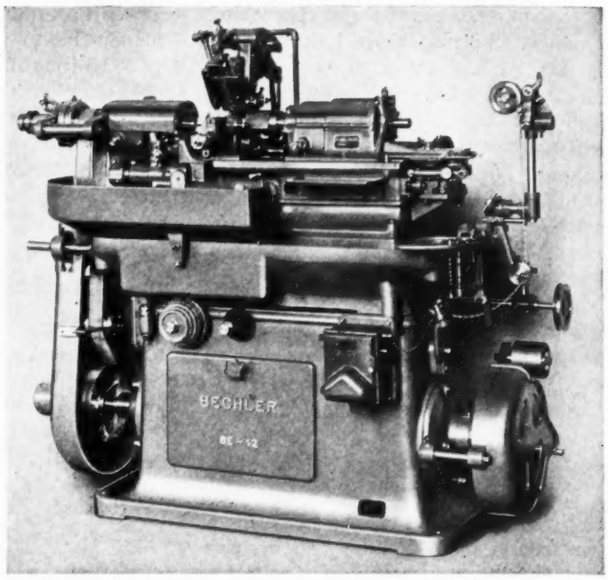
A sensitized foil for duplicating tracings has been developed by the Ozalid Corporation, 354 Fourth Ave., New York City. Copies of tracings are made on this foil in the same manner as on ordinary Ozalid print paper. A foil print can be made of an original drawing having weak lines and a smudgy background. From the new foil print, paper prints can be made which will have stronger lines and clearer backgrounds than the original drawing or tracing.

The base material of the foil is cellulose acetate and is non-inflammable, strong, and permanent. A clear foil, 0.005 inch thick, is made with a glossy finish on both sides. Another foil, 0.0075 inch thick, has a mat finish on one side that will take pencil and ink lines. The image is embedded in the foil and is not affected by light or washing. The block-out method or "Ozalid corrector fluid" can be used to block out on the foil copy that portion of a design to be changed. The desired changes can then be made on the foil in pencil or ink. The transparency of the foil permits as many as six layers to be used in producing a composite print showing group details of all six foil copies. ..... 89

To obtain additional information on equipment described on this page, see lower part of page 806.



Bench Lathe Unit with Overhead Drive Made by the Elgin Tool Works




Bechler Automatic Screw Machine Built in Three Sizes with Capacities of 1/2, 5/8, and 3/4 Inch

## Elgin Bench Lathe Unit

A bench lathe unit adapted especially for tool-room, experimental, and model work in aircraft, arsenal, and general industrial plants has been brought out by the Elgin Tool Works, Berteau and Ravenswood Ave., Chicago, Ill. The complete unit is shown in the illustration, with a regular Elgin tool-room lathe mounted on the bench top, which is of hard maple, worked down to a "satin finish."

The overhead drive of the unit furnishes speeds ranging from 40 to 1800 R.P.M. for plain-bearing lathe heads and from 40 to 3400 R.P.M. for ball-bearing heads. These speeds are available in either direction of rotation through the operation of a control lever. The range of speeds provided is ample for turning all large and small work ordinarily handled in tool-room lathes. Any speed desired for the grinding attachment can be obtained from the countershaft, which has a speed of 1720 R. P. M. The unit is furnished complete, including electric light, ready for connection with the electric power circuit.....90

## Allen-Bradley Push-Button Control Stations

A new line of standard-duty, push-button control stations has been developed by the Allen-Bradley Co., 1311 S. First St., Milwaukee, Wis. These new Bulletin 800 stations are available in single-button and double-button types that are styled to harmonize with modern machinery.

The stations are enclosed by a reinforced Bakelite cover mounted on a die-cast frame. The Bakelite cover is regularly furnished in black, but may be provided in machine tool gray or in white. By removing a single screw, the coved can be taken off to expose all terminals. A conduit opening is provided at one end of the die-cast frame.

This equipment is available in both the horizontal and vertical types, with a maximum direct-current rating of 1 ampere, 115 volts; 0.5 ampere, 230 volts; 0.25 ampere, 550 volts; and a maximum alternating-current rating of 3 amperes, 110-220-440-550 volts.....91

Push-button Control Made by the Allen-Bradley Co.

## Bechler Universal Precision Automatic Screw Machine

The new model Swiss Bechler universal precision automatic screw machine here illustrated is being placed on the market in this country by the Triplex Machine Tool Corporation, 125 Barclay St., New York City. This machine is made in three sizes which take bar stock having maximum diameters of 1/2, 5/8, and 3/4 inch. It is built for precision work and is similar in design to the lighter machines made by the same company for producing precision parts for electrical products, accounting machines, gages, cameras, watches and clocks, speedometers, textile machines, automobile and airplane accessories, etc.

In these machines, the stock travels intermittently past the tools, the latter having no longitudinal movement. The headstock spindle, which rotates the bar stock, advances and recedes along a slide and pushes the bar through a fixed bushing located just behind the tools.

Four tool-holders are furnished, two horizontal and two vertical. Each tool works independently, and is provided with double micrometer adjustment. In addition to these tools, the two scraped surfaces at the front of the machine are arranged to take various plain and combined attachments for drilling, threading, tapping, slotting, etc. The machines are regularly furnished for motor drive, but can also be furnished for belt drive.....92



To obtain additional information on equipment described on this page, see lower part of page 806.

## National Spline Taper-Drive Counterbores

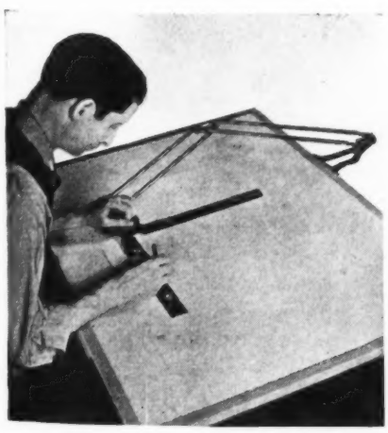
To the line of spline taper-drive counterbores described in January, 1938, MACHINERY, page 349, the National Twist Drill & Tool Co., Detroit, Mich., has added sets of counterbores designed to meet the needs of the average tool-room and small shop. The No. 2 tool-room set illustrated has two holders and interchangeable cutters ranging from 1/2 inch to 1 1/4 inches in diameter. Pilots from 9/32 to 7/8 inch in diameter are interchangeable within the respective ranges of the cutters and holders. There are also countersinks for 60-, 82-, and 90-degree included angles. The 60-degree cutter is intended for centering work, while the 82- and 90-degree cutters are intended for countersunk-head screws.

A No. 1 set with counterbores ranging from 1/4 to 7/16 inch in diameter, and a No. 3 set having a range up to 3 inches in diameter are also available. These sets come in strong wood boxes with recesses to suit the individual tools. ..... 93

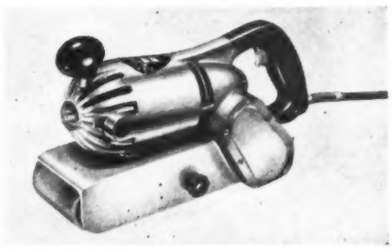
Set of Tool-room Counterbores and Countersinks Made by the National Twist Drill & Tool Co.

## "Reliance" Drafting Machine

A low-priced drafting machine designed for convenience, accuracy and speed in making drawings up to 23 by 28 inches, where the volume or type of work does not warrant the use of the larger, more expensive units, has been placed on the market by Eugene Dietzgen Co., 2425 Sheffield Ave., Chicago, Ill. This new drafting machine, known as the "Reliance," is light in weight, but of strong anchor construction. Adjustment features compensate for natural wear. The protractor turns through a complete circle of 360 degrees, and has easy thumb control of a new angle lock. The scale chuck takes any standard stock scale. ..... 94



"Reliance" Light-weight Drafting Machine



Skilsaw "Zephyrplane" Belt Sander

## Skilsaw Belt Sander

A streamline 3-inch belt sander known as the "Zephyrplane" is being placed on the market by Skilsaw, Inc., 5039 Elston Ave., Chicago, Ill. This sander has been developed especially for work that does not require larger and more expensive equipment, being particularly suited for general maintenance work in industrial plants, woodworking shops, and manual training classrooms. It is designed to provide uniform pressure over the entire sanding surface, is light in weight, and easy to handle. An interchangeable knob-handle can be moved from the top to the nose of the sander for convenience in sanding vertical surfaces.

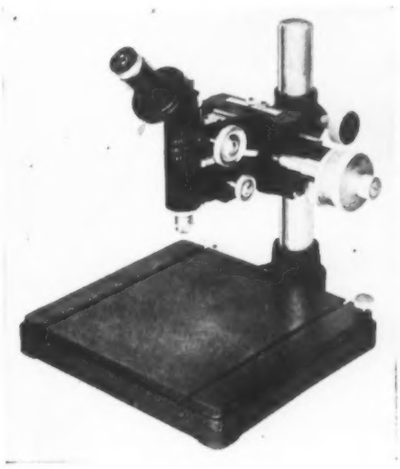
A feature of this sander is the "touch control" lever that instantly releases the tension on the sanding belt, so that the changing of belts becomes a very simple operation. The pressure-control trigger switch, which makes accidental starting impossible, is mounted in a Bakelite handle. This handle is a non-conductor of electricity and always remains cool while sanding. A belt speed of 1200 surface feet per minute permits fast sanding and the production of smooth, even surfaces without ripples or ridges. The complete tool weighs 13 1/4 pounds. ..... 95

## Leitz Measuring Microscope for Shop Use

The George Scherr Co., 128 Lafayette St., New York City, has just placed on the market a new model Leitz measuring microscope especially developed for use in shops, inspection departments, and laboratories. The microscope is mounted on a heavy baseplate, but can be removed and used on machines or fixtures as a self-contained unit.

The instrument is designed for measuring in one linear direction. It has a range of 2 inches, obtained by means of a precision micrometer screw with a large dull-chromium-finished drum, which is graduated directly to 0.0001 inch. A split nut within the micrometer screw can be used for quick setting.

The microscope has an inclined ocular containing cross-hairs, with means for centering the eye-piece co-axially. The focussing is accomplished by means of a rack and pinion motion and a large knurled knob. A second knob with a graduated dial is provided for independent fine focussing, which makes it possible to obtain positive depth measurements by using an objective of higher power. ..... 96



Leitz Measuring Microscope for Shop Use

To obtain additional information on equipment described on this page, see lower part of page 806.

*Announcing the 1939*

# MACHINE TOOL SHOW

**THE GREATEST EXHIBIT OF THE TOOLS OF INDUSTRY EVER PRESENTED**

*Cleveland*

**OCTOBER 4-13, 1939**

**NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION**

10525 CARNEGIE AVENUE, CLEVELAND, OHIO

### EXHIBITS

The 195 exhibits, occupying 150,000 square feet of floor space, will display nearly 1,000 machines. These will include every type of machine tool in its most modern form, and in full operation . . . also many types of allied equipment and accessories. Every facility will be afforded visitors for careful, thorough inspection.

### MACHINE TOOL CONGRESS

A Machine Tool Congress, sponsored by the professional engineering societies, will be held in evening sessions during the period of the Show. Foremost authorities will speak at the forum meetings of this Congress, on important developments in manufacturing methods.

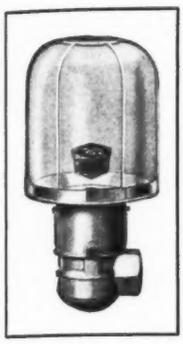
### ATTENDANCE

Attendance will be limited to qualified visitors. Admission to the Machine Tool Show will be by registration only. Among those attending will be officers and directors of manufacturing companies, operating executives, engineers, production men, buyers. More than 50,000 people visited the Machine Tool Show of 1935.

**YOUR SMARTEST INVESTMENT TODAY . . . MODERN MACHINE TOOLS**

## Trico Unbreakable Constant-Level Oiler

A new line of visible, automatic, constant-level oilers, with unbreakable reservoirs and provision for adjusting the oil level, has been placed on the market by the Trico Fuse Mfg. Co., Milwaukee, Wis. These oilers automatically maintain the proper oil level in ring or ball bearings, gear and pump housings, etc. One filling of the reservoir is sufficient to lubricate a bearing three months or longer without attention. This oiler is made in 1, 2, 4, and 8-ounce capacities, with interchangeable reservoirs. Two styles are available for standard-surge and high-surge levels having side outlets only or side and bottom outlets for drainage. ..... 97

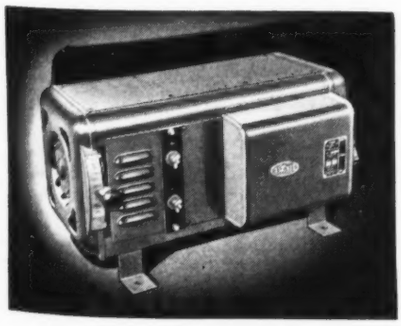


Trico Constant-level Oiler

## Square-Frame Welder for Multi-Arc Welding

The Harnischfeger Corporation, 4400 W. National Ave., Milwaukee, Wis., has added to its line of P & H-Hansen electric arc welders a Model WA-200 square-frame welder for multi-arc service. This welder is of simple, compact design. It occupies less than 3 1/2 square feet of floor space and provides a welding range of from 40 to 225 amperes.

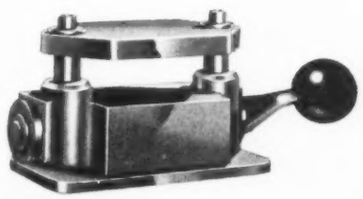
The spring-mounted louvres can be quickly removed and replaced to permit inspection of the brushes or commutator or for making minor adjustments. The top and plates can also be easily removed. The new type of patented frame is of rigid construction and is designed to protect the bearings from misalignment and wear. The rotating member is statically and dynamically balanced, making the machine practically free from vibration. These units can be hooked up in parallel, without special adjustments, to obtain a wide range of welding amperage. ..... 98



P & H-Hansen Square-frame Welder

## Esco "Mijit" Drill Jig for Small Parts

Esco Engineering & Sales, Inc., 4612 Woodward Ave., Detroit, Mich., has recently developed a small-sized drill jig known as the "Mijit," which is designed to meet the requirements of plants manufacturing small parts. This jig is provided with a positive lock and weighs less than 6 pounds. It is made with working areas ranging from 1 1/4 by 2 1/4 inches, in the smallest type, up to 3 by 3 inches in the largest type. Four standard models are available having a standard lift of 1 inch. The positions of the guide posts are variable.

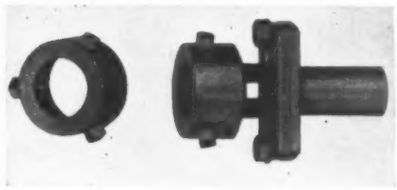


Esco "Mijit" Drill Jig

The drill bushings are held in the top plate and the work-holding units are fastened to the under side of the top plate and to the upper face of the baseplate for locating the work in the correct relation to the drill bushings. The jig is operated manually by the ball-shaped Bakelite knob at the end of the steel arm. The releasing and locking of the work by means of this lever is accomplished with little effort. One jig can be adapted for handling numerous parts. ..... 99

## Alco Button Type Die-Holder

A button type die-holder with an adjustable concentric alignment feature, designed to save set-up time and eliminate the difficulties often experienced in obtaining concentricity when using button dies, has been brought out by the Alco Tool Co., 835 Housatonic Ave., Bridgeport, Conn. In using this holder, it is simply necessary to tighten the die in the die cap, adjust the floating device, and tighten the two clamping studs. Adjusting the device in this manner insures straight threads.



Button Type Die-holder Made by the Alco Tool Co.

One of the three set-screws shown in the illustration is pointed to permit it to be used for expanding the dies when necessary. The floating feature permits the die to be run over the work before tightening the flange in order to insure accurate, concentric alignment. The holder is so designed as to provide ample space for chips and lubricant. ..... 100

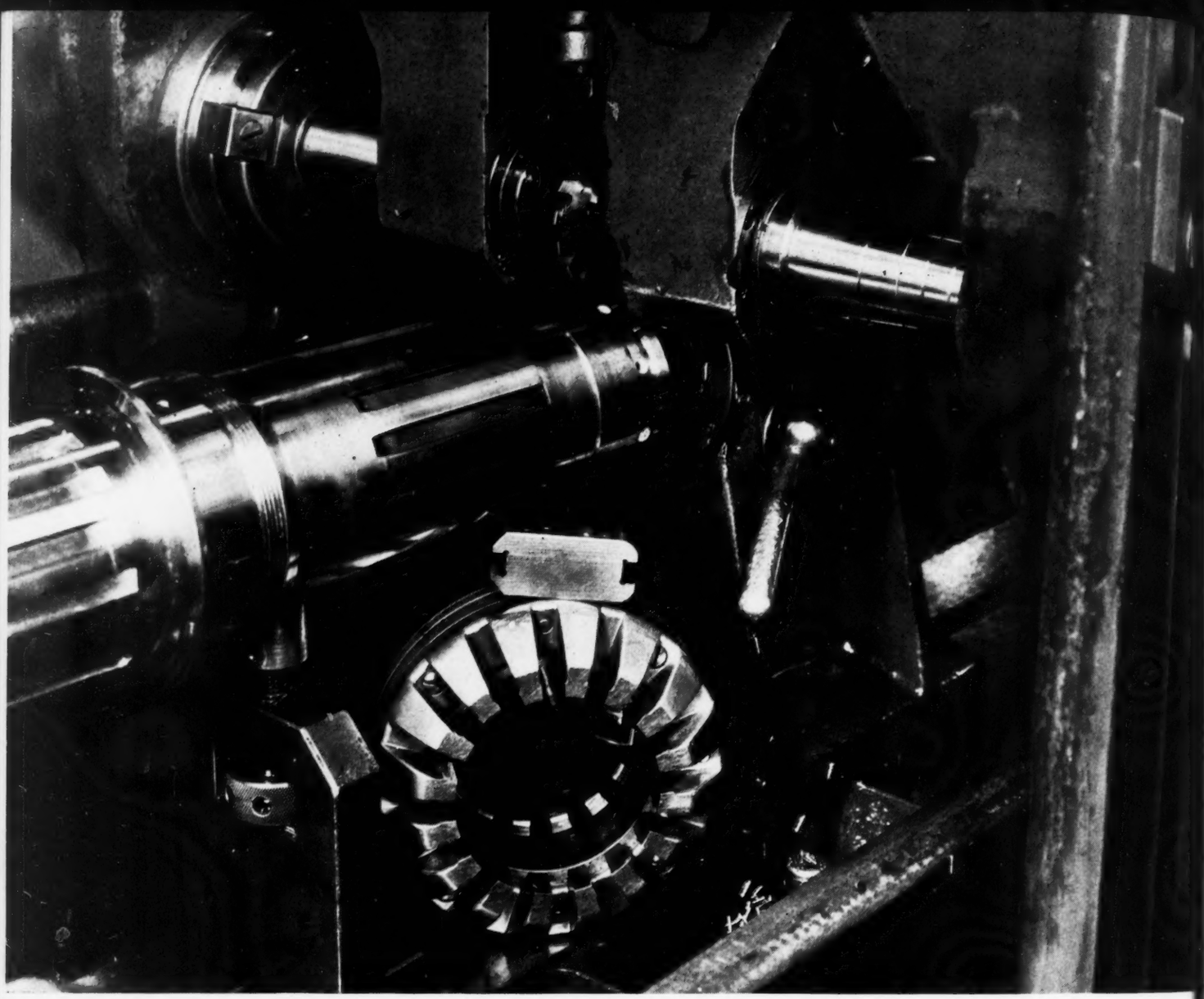
* * *

## Tool Engineers Meet in Elmira

Eighty-five members and guests of the Elmira Chapter of the American Society of Tool Engineers and The Industrial Management Association of the Elmira District, representing thirty industrial plants, were present at a dinner meeting in Elmira June 16, at which Tell Berna, general manager of the National Machine Tool Builders' Association, spoke on "The Tool Engineer and the Machine Tool Industry," and E. C. Brandt of the Westinghouse Electric & Mfg. Co. on "Rehabilitation of Industry as an Aid to Relieving Economic Distress." Mr. Berna stressed the common interests of the machine tool builders and the tool engineers in producing better and cheaper products, and also announced the National Machine Tool Show, to be held in Cleveland, Ohio, October 4 to 13.

Mr. Brandt pointed out the responsibility of industry in the maintenance and modernization of buildings, machinery, and other equipment during periods when production is below normal. The importance of absorbing into industry a fair proportion of the thousands of young men just being graduated from high schools and colleges was impressed upon the group of plant managers and engineers present.

To obtain additional information on equipment described on this page, see lower part of page 806.



# *Aircraft Accuracy*

## WITH A № 12 — ELECTRICALLY CONTROLLED

**— in this instance an UNUSUALLY accurate job . . . . climb milling splines on a motor crankshaft . . . . each spline milled in a single cut from the solid . . . . one of the many No. 12 installations serving Modern Aviation.**

B·S

BROWN &

**COMPLETE ELECTRICAL CONTROL**

**of all power movements of both table and spindle gives unusually precise, smooth performance, with outstanding flexibility of operation.**

**CLIMB MILLING—through the automatic backlash eliminator, permits new economies in production milling with the No. 12 Plain Milling Machine—Specifications on request. Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.**

# &SHARPE

# Master Gage for Checking Distance between Knife-Edge Pivots of Scale Levers

CERTAIN parts assembled in the mechanism of a weighing scale cannot be standardized because of the many modifications necessary in scales constructed for special purposes. These modifications introduce measuring or gaging problems that must be solved in an efficient manner in order to avoid upsetting production schedules. The most important dimension on heavy-capacity scale levers is the spread or distance between the knife-edges. Since this distance determines the multiplication or ratio of the levers, the levers can only be as accurate as the spread dimension. If there were only a few sizes of levers, the problem would be relatively simple, as standard gages could be made for each size, but with an almost infinite variety of standard and special levers, the problem is a complex one.

Recently, engineers of the Toledo Scale Co., Toledo, Ohio, installed a master gage which enabled them to overcome a measuring problem in the manufacture of these levers that had given considerable trouble. The new master gage and spread gage shown in Fig. 1 have been designed to measure with great precision any type of lever, whether for a standard or a specially built scale. The master gage is built on a bed casting *A* about 7 feet long. This bed is made of Meehanite, Grade C, and normalized to remove all strains. Movable blocks *B* which rest on the top surface of the main casting and are located by keys fitted snugly into the center slot hold master knife-edges *C* exactly at right angles to the slots in the bed casting. The knife-edges are always parallel with each other and in the same plane, regardless of the positions in which they are clamped on the bed.

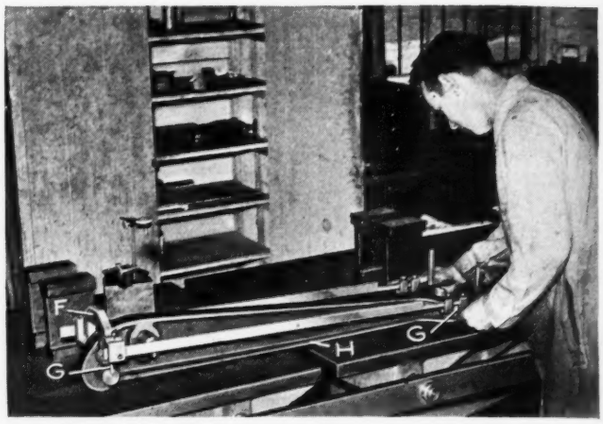



Fig. 2. Checking the Distance Between the Knife-edge Pivots G of Lever H by Means of Spread Gage F Adjusted to Duplicate Setting of Master Gage

Above the master gage shown in Fig. 1 is a case *D* which holds a special set of inside micrometers and measuring rods made for measuring any distance up to 100 inches by thousandths of an inch. To set the master gage to the pivot distance required, the proper rods are first selected and assembled to a micrometer barrel. This assembly is then placed between the ground buttons on the inside of the adjustable blocks, as shown at *E*.

After the blocks have been set by means of the measuring rod and micrometer assembly *E*, an adjustable spread gage *F* is placed on them and adjusted in the manner shown in Fig. 1 to duplicate precisely the pivot spacing of the master gage. The adjustable spread gage is next transferred to the lever itself, as shown in Fig. 2. The pivots *G* for the lever are then twisted or touched up with a hone, if required, so that a zero reading is obtained on the indicators of the spread gage. The knife-edges of the lever are now exactly the same distance apart as those on the master gage.

The parallel blocks and surface gage shown in the background of Fig. 2 are used for checking the range of the lever movement. This illustration also shows portions of two of the special surface plates provided for large lever work.

* * *

Accomplishment, as measured in terms of usefulness, is the true measure of individual success.

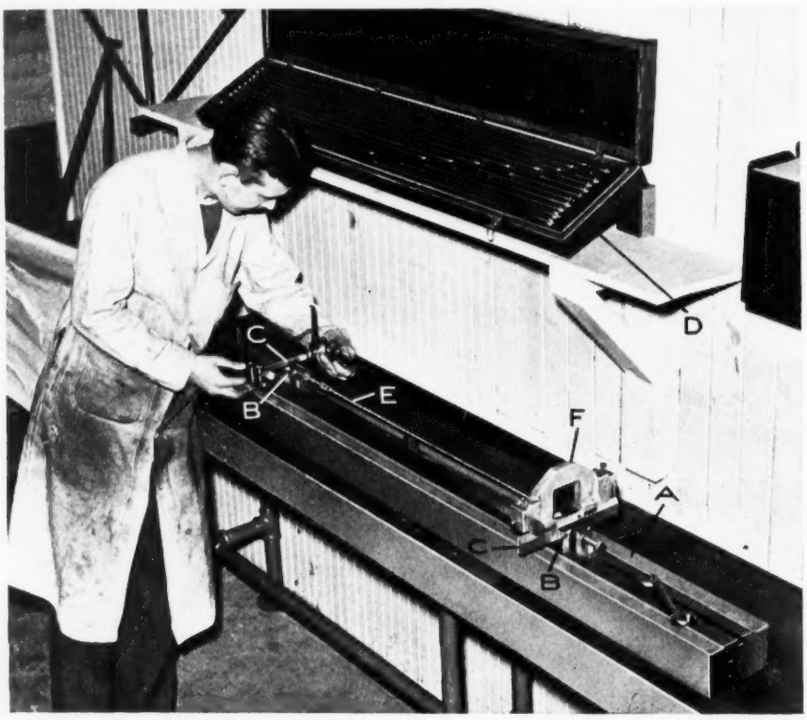
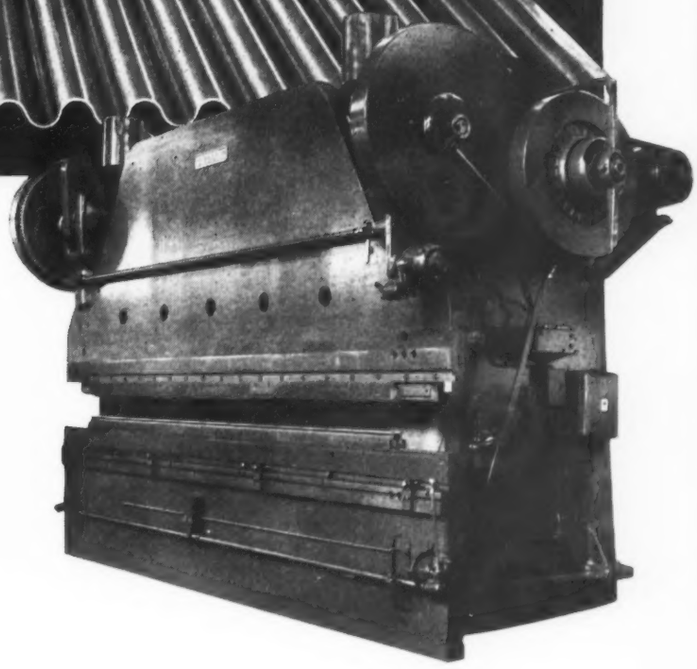



Fig. 1. Master Gage with Accurately Spaced Knife-edges C Set by a Micrometer Rod E from Case D; and Spread Gage F which is Being Adjusted to Duplicate Setting of Master Gage

16′ sheets for modern transport planes, formed on a 340 Series Cincinnati All-Steel Press Brake.



**FOR the Wings of Man . . . aluminum alloy sheets must be accurately corrugated . . . a job typical of the machine tool accuracy of Cincinnati Press Brakes . . .**

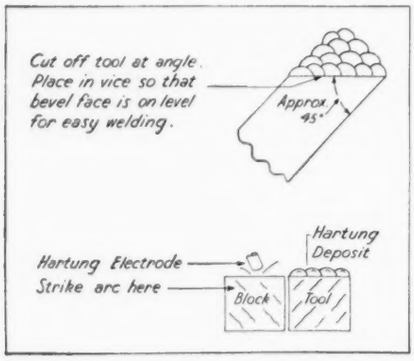
**THE CINCINNATI SHAPER COMPANY**

**CINCINNATI, OHIO**

# Building up Boring Tools with Tungsten-Base Electrodes

By F. J. HIRNER
Harnischfeger Corporation, Milwaukee, Wis.

To obtain the best results in building up heavy tools with Smootharc Hartung electrodes or any electrode having a similar tungsten base, experience has shown that the procedure should be as follows: When building up heavy tools on a carbon steel base, it is well to cut off the end of the tool at an angle of about 45 degrees, as indicated in the illustration, instead of following the common practice of grinding out a square recess for the electrode deposit. This provides a solid base beneath the cutting edge and prevents the base steel that is just below the tungsten from collapsing if it becomes overheated in operation. It also gives minimum dilution at the cutting edge.


Cut off tool at angle. Place in vice so that bevel face is on level for easy welding.
Approx. 45°
Hartung Deposit
Hartung Electrode
Strike arc here
Block
Tool

Diagrams Showing Method of Building up Boring Tools with Tungsten-base Electrodes

For the most uniform results, the arc should not be struck on the tool face or on the tungsten deposit, but should be started on a "striking" block placed beside the tool, as indicated. It is always necessary, in rebuilding high-speed tools, to preheat them to 400 or 500 degrees F. If any touching up is necessary after grinding, the tool must again be heated to 400 degrees before rewelding or depositing additional metal.

Several manufacturers have reported great success in obtaining added service from boring and cutting tools treated in the manner described. A Chicago concern manufacturing railroad car wheels, for instance, found that drills resurfaced with Hartung electrodes would bore the hubs of 94 wheels, as compared with the record of 30 wheels obtained with the tool previously employed. In another plant where the problem was one of taking inside and outside surface cuts on a large cast chilled drum, the tool made by building up a Hartung edge on 1040 steel stock faced the drum inside and out without a sign of wear while operating at a speed 10 per cent faster than used for the regular tool.

# Economic Planning for the Machinery Industries in Germany

According to the *World Machinery News*, published by the Machinery Division of the Bureau of Foreign and Domestic Commerce, Washington, D. C., economic planning in Germany has been carried another step forward by the appointment of a Commissioner for the Machinery Industry. Karl Lange, for many years director of the Association of German Machine Builders, the organization of the German machine-building industries, is the head of the newly organized machine industry division of the government.

One of the main duties of the Machinery Commissioner will be to expand industrial production, now largely a question of increasing the supply of machinery and of mechanizing, as far as possible, all labor processes. Since the available labor supply in Germany is already utilized to its capacity, and since the machinery industry is swamped with orders for years ahead, it will, be necessary to establish a definite priority for orders, so that urgently needed equipment will be executed in preference to other of less importance. Since the greater supply of machinery for all other industries is predicated on an increase in the capacity of the machine tool building industry, the production of machine tools—the machines that build machines—is considered of prime importance.

# Landis Speed Calculator for Grinding Operations

The Landis Tool Co., Waynesboro, Pa., has just made a convenient speed calculator available to those responsible for the operation of grinding equipment. One side of the calculator makes it a simple matter to compute quickly the revolutions per minute of the grinding wheel for six different surface speeds, covering wheel diameters ranging from 1 inch to 42 inches.

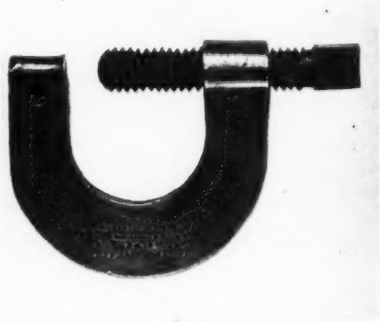
The reverse side of the calculator makes it equally convenient to compute the revolutions of the work per minute for four different surface speeds, covering work diameters of from 1/2 inch to 10 inches. Concise information on wheel and work speeds is also given. These calculators can be obtained if requests are sent on company letter-heads.

* * *

# The Versatility of the Micrometer

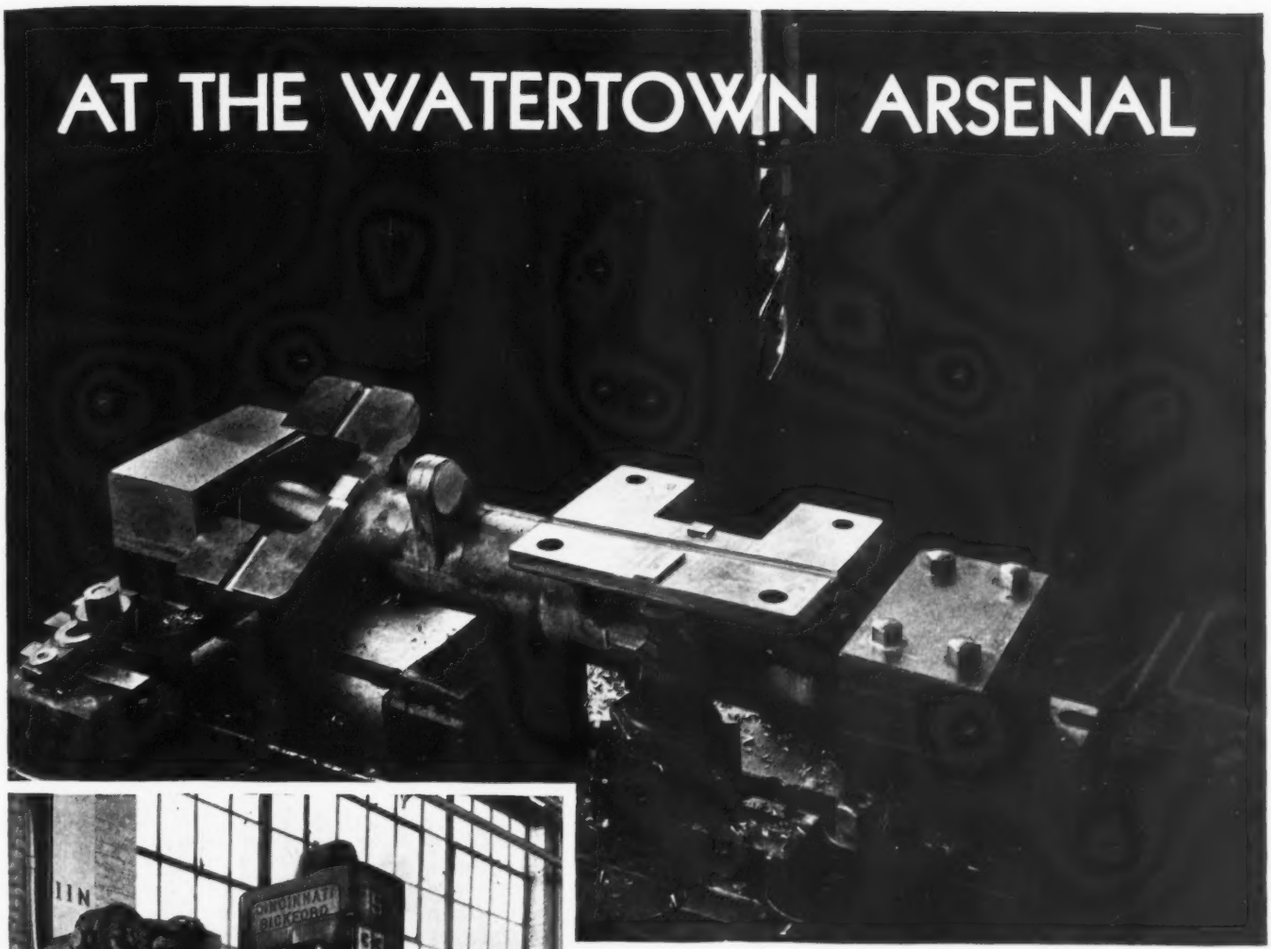
By ARMAND JASMIN

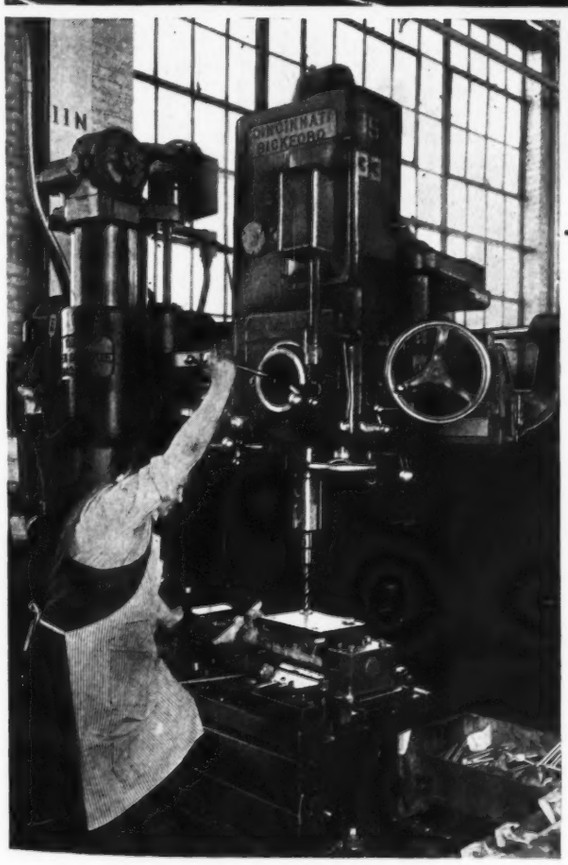
I have always recognized the universal application of the micrometer, but only recently discovered a new use for a micrometer frame. For years I have carried on a small business by visiting second-hand stores, looking for machinist's tools which can be reclaimed and sold. Not long ago I came across a C-clamp made from a square-head set-screw and an old micrometer frame. This seemed to me such an unusual use for a micrometer frame that I thought it would be worthy of mention. It shows that the micrometer can be "useful" even after it has outlived its usefulness.



An Unusual Use for a Micrometer Frame

# AT THE WATERTOWN ARSENAL






## –example of Super-Service Radial Drill Performance

Illustrated is a Gun Mount job at the Watertown Arsenal. This calls for the extremely accurate drilling of nine holes in the bronze bracket shown in the close-up above. The machine is a Cincinnati Bickford Super-Service Radial with a 4-foot arm. A number of exclusive features of the Super-Service Radial makes it advantageous for the precise workmanship of arsenal and aircraft production. First of all, 36 selective speeds in geometric progression with no overlapping, no duplication. Then the 18 feed changes, also in geometric progression—the smooth herringbone gears—the constant speed multiple driving clutches—the extra long spindle sleeve bearing—the many safety features for the protection of the operator and of valuable tools—the convenience of low and centralized controls. These, and many other features, quickly indicate the value of the Super-Service Radial for ordnance work, for aircraft manufacture, for commercial production.

*Bulletin R-24 giving full particulars will be sent without obligation.*

RADIAL AND UPRIGHT DRILLING MACHINES

SUPER SERVICE C B

THE CINCINNATI BICKFORD TOOL CO. OAKLEY, CINCINNATI, OHIO, U.S.A.

# NEWS OF THE INDUSTRY

## Illinois and Indiana

Dr. C. O. SAPPINGTON, Chicago, Ill., has been given the W. S. Knudsen Award for the most outstanding contribution to industrial medicine during the past year. This award was instituted by W. S. Knudsen, president of the General Motors Corporation.

EUGENE F. BOHACH, 163 E. Walton Place, Chicago, Ill., has been appointed midwestern representative of Greene, Tweed & Co., 101 Park Ave., New York City, in place of V. B. NICKERSON, who recently resigned.

LINK-BELT CO., Chicago, Ill., has been appointed by the TWIN DISC CLUTCH CO., Racine, Wis., as distributor for Twin Disc friction clutches and clutch couplings in all industrial fields.

CONTINENTAL ROLL & STEEL FOUNDRY CO., East Chicago, Ind., has acquired the HOWELL ENGINEERING CO., St. Charles, Ill., manufacturer of automatic polishing and buffing equipment. The engineering, service, and sales staffs have also been taken over. The Howell company's products will now carry the name "Continental" and will be made at the various plants of the Continental company.

## Michigan and Wisconsin

HONING EQUIPMENT CORPORATION, 4612 Woodward Ave., Detroit, Mich., has been organized to develop and manufacture honing machines and tools of various sizes and models, and to furnish engineering service on honing problems. J. A. CARLIN, president of the new company, was vice-president and general manager of the Hutto Engineering Co., Inc. In 1935, when the Carborundum Co. took over the Hutto business, he was retained as general manager of the new division, which position he held until the Carborundum Co. sold the business. C. W. FLOSS, vice-president in charge of engineering of the new company, was one of the organizers and engineers of the Jeschke Tool Corporation, which later became the Micromatic Hone Corporation. He has also been connected as an engineer with the automotive industry for many years. The tools to be marketed by the company will be manufactured under the Floss patents.

LEONARD E. NICHOLS, formerly chief welding engineer of the National Electric Welding Machines Co., Bay City, Mich., has been appointed technical advisor and sales engineer for the Detroit district sales division. The Detroit offices of the company have been removed from the Stormfeltz-Lovely Bldg. to Room 6-255 General Motors Bldg., Detroit.

CROBALT, INC., Detroit, Mich., maker of non-ferrous cutting tools and wear plates, has appointed HEARTLY W. ANDERSON as sales representative. Mr. Anderson is a graduate of Notre Dame University, where as "Hunk" Anderson he made football history. During the past few years he has devoted himself to metallurgy, particularly in connection with production cutting tools.

THOMAS B. MOULE, advertising manager of the Ex-Cell-O Corporation, Detroit, Mich., has been elected vice-president of the Industrial Marketers of Detroit, which is a chapter of the National Industrial Advertisers' Association.

G. S. CRANE has been made vice-president in charge of sales and engineering of Cutler-Hammer, Inc., Milwaukee, Wis. In addition to his sales responsibilities, he assumes supervision of the company's development work, and executive control of the engineering, drafting, and patent departments. Mr. Crane has been associated with the Cutler-Hammer organization for twenty-nine years in engineering and sales capacities.

## New England

PRODUCTION MACHINE CO., Greenfield, Mass., has purchased the business of the FRANCIS REED CO., Worcester, Mass., an old and well-known manufacturer of sensitive drilling machines manufactured under the trade name "Reed" and formerly under the trade name "Barr."

NORMA-HOFFMANN BEARINGS CORPORATION, Stamford, Conn., announces the election of the following officers: W. M. NONES, chairman of the board; O. P. WILSON, president and treasurer; H. J. RITTER, vice-president and secretary; and C. B. MALONE, vice-president in charge of plant operations.

## New Jersey and Delaware

VAN DORN ELECTRIC TOOL CO., Towson, Md., has opened a new branch service station at 605 McCarter Highway, Newark, N. J. HARRY BULLOCK has been transferred from the factory at Towson to take charge of the new branch.

LOBDELL CAR WHEEL CO., Wilmington, Del., has purchased the business of the NAZEL ENGINEERING & MACHINE WORKS, Philadelphia, Pa., and will continue the manufacture of the Nazel air hammer and the Dill slotter under the direction of HOWARD W. WIMER, who has been associated with the Nazel business for thirty-five years.

## New York

PORTER-CABLE MACHINE CO., Syracuse, N. Y., manufacturer of portable and stationary sanding and sawing machines, has added 90,000 square feet to its manufacturing facilities through the purchase of adjoining land and buildings. The new manufacturing space will be occupied at once, as the increasing business has outgrown the present facilities. The plant now has frontage on four streets, railroad siding, and ample storage facilities.

EDWIN J. SCHWANHAUSSER has been elected a vice-president of the Worthington Pump & Machinery Corporation, Harrison, N. J. Mr. Schwanhausser has been with the Worthington organization since 1915, when he graduated from Stevens Institute of Technology. He has served in a number of capacities and became assistant works manager in 1927. In 1929 he was transferred to the Buffalo Works as works manager, which position he now holds.

RALPH M. NEUMANN has been appointed general sales manager and ARTHUR E. MERVINE assistant general sales manager of the New Jersey Zinc Co. and the New Jersey Zinc Sales Co., New York City. Mr. Neumann will also continue as manager of the Pigment Division of the New Jersey Zinc Sales Co. Mr. Mervine will continue as manager of the Metal Division of the New Jersey Zinc Sales Co.

JOHN M. WALL, who has been connected with the J. M. Wall Machine Co., Inc., Syracuse, N. Y., has severed his connections with this company and is now located at 107 N. Franklin St., Syracuse, where he is building professional motion picture cameras, and developing and engineering new products.

W. J. PARKER, INC., 7 E. 44th St., New York City, has been organized by W. J. Parker, who, for twelve years, was commissioner of the National Battery Manufacturers Association, Inc. The newly formed business will be devoted to the organizing and managing of national trade associations.

HASLER-TEL CO., sole distributor in the United States for the Hasler speed indicator, has removed from 461 Eighth Ave., New York City, to larger quarters in the Underwood Building, 30 Vesey St.

MARSHALL L. HAVEY has been elected a vice-president of the New Jersey Zinc Co., New York City, and its subsidiaries.

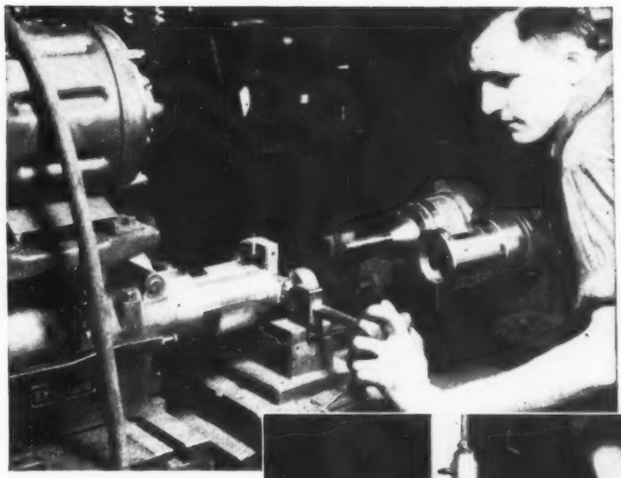
# PRODUCTION DOUBLED ACCURACY INCREASED EFFICIENCY IMPROVED

*with*

## *Ex-Cell-O Precision Boring Machines*

Over a period of several years the Universal Cooler Corporation of Detroit has installed five Ex-Cell-O Precision Boring, Turning and Facing Machines for precision parts used in refrigerator compressors. In every case, output per machine has been doubled and both accuracy and finish have been improved. Universal has not only reduced manufacturing costs, but has increased the efficiency and performance of its refrigerators by using Ex-Cell-O machines.

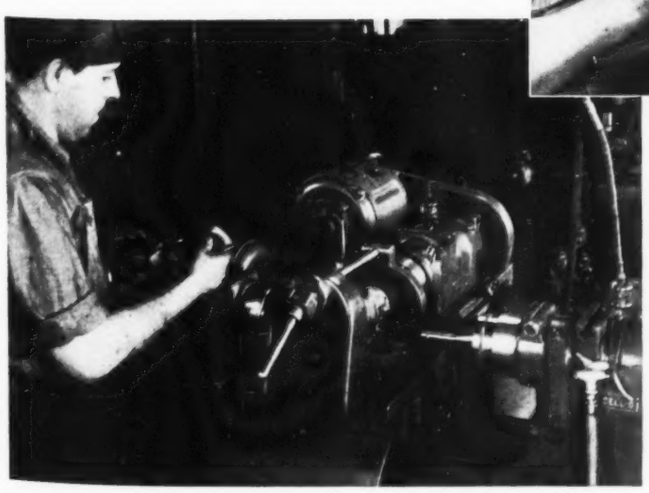
If you are not getting satisfactory production, or accuracy, or finish on your bored, turned or faced parts, get in touch with Ex-Cell-O. No obligation for the facts on this money-saving equipment. Write today to Ex-Cell-O Corporation, 1212 Oakman Boulevard, Detroit, Mich.



Two grinding machines and two reaming operations were replaced with the one Ex-Cell-O machine above, finish turning and boring crankshaft cams.

Universal doubled production, and increased accuracy, with the Ex-Cell-O machine at the right, facing compressor seals flat within .000015".

Boring both ends of connecting rods simultaneously, on the Ex-Cell-O machine above has doubled production and improved both accuracy and finish.



Two Ex-Cell-O machines like that at the left have replaced four other machines, and, by boring cylinder bores and cross bores simultaneously, have increased accuracy of size and alignment.

# EX-CELL-O

CORPORATION • DETROIT, MICHIGAN

## Ohio

MONARCH MACHINE TOOL CO., Sidney, Ohio, celebrated the completion of its new factory and office building with a two-day "open house," June 24 and 25. The company started in 1909 with twenty-five men. The present plant, in which 570 men and women are employed, is of most modern construction and air-conditioned. The new building increases the plant area 35 per cent—to 135,000 square feet, which is almost twice the size of the plant in 1929. In addition to facilities for final assembly, designing, and engineering departments, the new building provides offices for all management personnel, an auditorium seating 500, a cafeteria and employes' lounge room, new quarters for apprentice training, a photographic laboratory, a blueprint room, and a large display and demonstration room.

THE LINDE AIR PRODUCTS CO., HAYNES STELLITE CO., and CARBIDE AND CARBON CHEMICALS CORPORATION, all of which are units of the Union Carbide and Carbon Corporation, have moved their Cleveland district offices to new quarters at 1517 Superior Ave., Cleveland, Ohio. H. H. DYAR is district manager for The Linde Air Products Co.; F. P. SHEPHARD for the Haynes Stellite Co.; and E. E. FOGLE for the Carbide and Carbon Chemicals Corporation.

DR. SAMUEL L. HOYT, well-known metallurgist, has become a member of the staff of the Battelle Memorial Institute, Columbus, Ohio. Dr. Hoyt was formerly director of metallurgical research with the A. O. Smith Corporation, Milwaukee, Wis. In his present capacity, he will act as technical advisor in the planning and conduct of metallurgical research at the Battelle Institute.

MONARCH ALUMINUM MFG. CO., 9300 Detroit Ave., Cleveland, Ohio, has added to its business a Dycast Products Division, with DAVID BENJAMIN as general manager of the division. Mr. Benjamin was formerly associated with the Gabriel Co. of Cleveland. In 1934 he founded Pressure Castings, Inc. The new division is equipped to produce die-castings from both aluminum and zinc alloys.

W. ROBERT TIMKEN has been appointed assistant to the president of the Timken Roller Bearing Co., Canton, Ohio. Mr. Timken graduated from Harvard University in 1933, and has since served in various capacities throughout the Timken plant.

DRESES MACHINE TOOL CO., 3366 Beekman St., Cincinnati, Ohio, manufacturer of radial drills and turret machinery, announces that the name of the company has been changed to the CINCINNATI GILBERT MACHINE TOOL CO.

OHIO GEAR CO., Cleveland, Ohio, has appointed the ST. LOUIS TOOL CO., 2317 N. 9th St., St. Louis, Mo., sales representative of the company in the St. Louis territory.

## Pennsylvania

FIRTH-STERLING STEEL CO., McKeesport, Pa., announces the following additions to the company's sales engineering staff: N. N. SHEPHERD, to act as Firthite engineer in Chicago; CLIFFORD W. NITCHIE, to act as Firthaloy die engineer in Chicago; LESLIE T. MCKINNON, to act as steel sales representative in Detroit; GEORGE L. SHARPE, to act as Firthite sales representative in Detroit; and A. W. MCCOY, to act as Firthaloy engineer in New York. J. W. MORDICA, formerly of the New York office, has been transferred to the home office; and F. H. BECKER, formerly of the Detroit office, has been transferred to Syracuse, N. Y., as Firthite engineer.

RICHARD RIMBACH has been appointed technical advisor to R. C. Enos, president of the Standard Steel Spring Co., Coraopolis, Pa. Mr. Rimbach will work on the development and promotion of a new process for coating steel with a pore-free metallic coating that will be especially advantageous in the manufacture of barrels, tanks, tubing, etc. Mr. Rimbach was formerly director of research for the Standard Steel Car Co., and editor of *Metals and Alloys*.

J. FREDERIC WIESE, who has been assistant to the vice-president of the Lukens Steel Co., Coatesville, Pa., since 1935, has been appointed general manager of sales. Mr. Wiese is a graduate of Swarthmore College, class of 1921. He was first employed by the Parkersburg Iron Co. In 1926, he joined the Lukens Steel Co., with whom he has held various positions culminating in his present appointment.

VINCENT H. GODFREY has joined the general sales staff of the Page Steel and Wire Division of the American Chain & Cable Co., Inc., with headquarters at Monessen, Pa. Mr. Godfrey, who is a graduate of the Annapolis Naval Academy, 1915, and a Lieutenant-Commander of the U. S. Navy (Retired), will specialize in the sale of Page welding electrodes and gas welding wire.

OLIVER SMALLEY, president of the Meehanite Metal Corporation and the Meehanite Research Institute of America, Inc., Pittsburgh, Pa., sailed for England on the *Georgic*, June 10. Mr. Smalley will spend about two months visiting a number of manufacturers of Meehanite in England, Norway, Sweden, and Continental Europe.

JOSEPH T. RYERSON & SON, INC., Chicago, Ill., have purchased the Philadelphia plant property of the Taylor-Wharton Iron and Steel Co. at 5200 Grays Ave., Philadelphia, Pa. Extensive improvements and additions are under way which will greatly enlarge the scope of the Ryerson service in the Philadelphia territory.

AMERICAN ENGINEERING CO., Aramingo and Cumberland Sts. Philadelphia, Pa., announces that it has purchased the DIAMOND MACHINE CO., Providence, R. I., and will continue the manufacture of the Diamond face grinder in its Philadelphia plant.

LUKE E. SAWYER, formerly assistant general superintendent of the Babcock & Wilcox Tube Co., Beaver Falls, Pa., has been appointed general superintendent.

HENRY A. WEYER, formerly connected with the Nazel Engineering & Machine Works, Philadelphia, Pa., is now associated with the Chambersburg Engineering Co., Chambersburg, Pa., in the capacity of engineer.

A. P. DE SANNO & SON, INC., manufacturers of abrasive products, have removed the firm's Philadelphia offices and factory to a new plant at Phoenixville, Pa.

## Texas and Colorado

HEWITT RUBBER CORPORATION, Buffalo, N. Y., has expanded its Dallas, Tex., warehouse facilities to take care of the demand for transmission belting, endless oil-field and agricultural belts, and conveyor belting.

INDEPENDENT PNEUMATIC TOOL CO., 260 S. Jefferson St., Chicago, Ill., has opened a branch office at 1544 Broadway, Denver, Colo., in charge of C. A. TURNQUIST.

# OBITUARIES

J. ALBERT MATTSON, who has been with the Firth-Sterling Steel Co., McKeesport, Pa., for thirty-one years, as sales representative in Chicago, Cincinnati, and Boston, died recently at his home in Chicago, at the age of sixty-five years. During recent years he was the company's representative in New England.

FRANK N. MEAD, who has been sales representative for the Firth-Sterling Steel Co., McKeesport, Pa., for thirty-eight years, recently died in Milwaukee, Wis., at the age of sixty-six.

* * *

The New York City Civil Service Commission, Municipal Bldg., Manhattan, New York City, announces a position available for an inspector of pipes and castings having at least five years' practical experience in foundry or machine shop in the casting and fabrication of cast iron and cast steel, two years of which must have been in the capacity of foreman or inspector. Salary ranges from $3000 per year upward.

# FASTERMATICS Help Speed Up AIRPLANE PRODUCTION

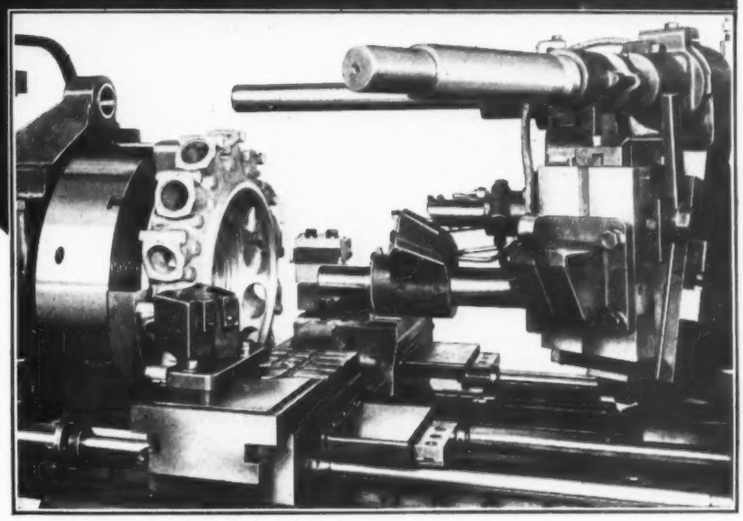
FOSTER FASTERMATICS are widely used by leading manufacturers of airplane engines and parts because they save both time and money, while filling the most exacting requirements for accuracy and quality.

The FASTERMATIC is a flexible, *automatic* turret lathe with hydraulic feeds. The automatic controls are simple, convenient and may be changed practically as easily as controls on a hand operated turret lathe. The set-ups are similar to the regular turret lathe and require about the same time.

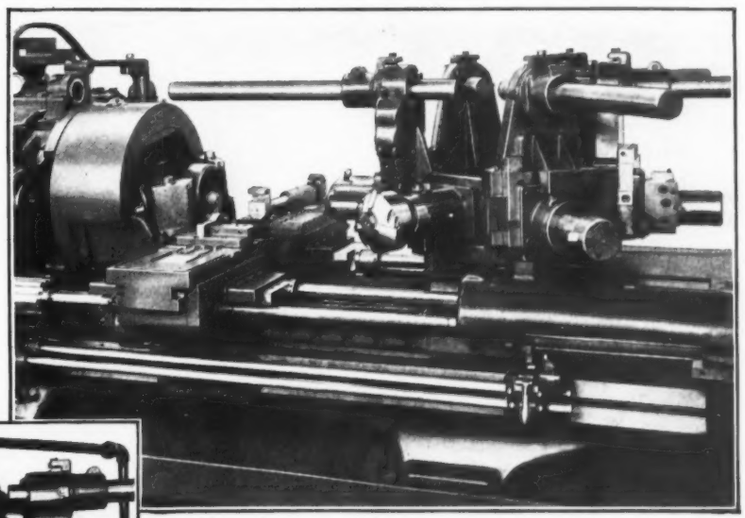
One operator handles several FASTERMATICS with less effort than one regular universal turret lathe. . . . Production per machine is greatly increased because the automatic completes the machining operations in the minimum time which cutting tools permit . . . Speeds and feeds, being automatically controlled, are not affected by inefficiency or fatigue of operator. . . . Steady, uniform production is assured throughout the entire day.

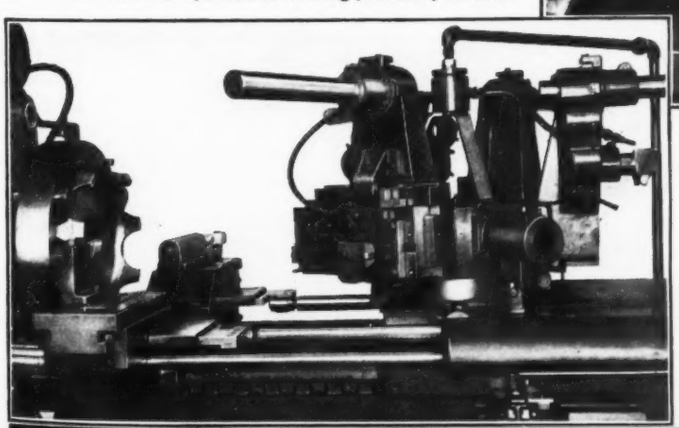
Full details furnished on request.

**FOSTER MACHINE CO., 702 Foster Bldg., Elkhart, Indiana**



*Above*:—No. 4F FASTERMATIC tooled for the machining of superchargers. One surface to be bored covers entire inside of housing shell, is an interrupted cut and must be bored to an irregular contour. Simultaneously two external faces are also completed by using multiple cutters. All these operations easily performed with greatly reduced machining time.





*Above*:—A FASTERMATIC set-up for the machining of 3 blade propeller hubs. The hub is chucked in an indexing fixture which is indexed by hand to the required positions. Entire cycle of operation is processed at each indexed position. Material used is steel, forged to shape. Hub is made in two piece halves.

*At Left*:—No. 4F FASTERMATIC tooled for machining crank cases. Considerable stock must be removed, tolerances are close, machining operations complicated and the finish required, unusually smooth. Because they meet all these requirements and also effect large savings over previous methods, FASTERMATICS are today preferred machines in the production of many airplane parts.

**FOSTER MACHINE CO., ELKHART, IND.**

MANUFACTURERS OF

FASTERMATICS . . TURRET LATHES

SCREW MACHINES . . SUPERFINISHERS

# NEW BOOKS AND PUBLICATIONS

ARC WELDING IN DESIGN, MANUFACTURE, AND CONSTRUCTION. 1408 pages, 6 by 9 inches; 695 illustrations. Published by the James F. Lincoln Arc Welding Foundation, P. O. Box 5728, Cleveland, Ohio. Price, $1.50 (postpaid) in the United States; $2 elsewhere.

This is undoubtedly the most comprehensive work on arc welding published up to the present time. It contains 109 original studies of welding, as described in the outstanding contributions to the recent Lincoln $200,000 Award Program. Of the 109 studies contained in the book, 29 relate to machinery and 9 to jigs and fixtures. The machinery section of the book contains 382 pages and 190 illustrations. With few exceptions, the papers are reproduced in complete form. Only those that were too lengthy to be included in their entirety have been comprehensively summarized. Each study includes designs, calculations, procedures, and other pertinent information showing how the advantages attributed to arc-welded construction are obtained.

The contents of the book are arranged in ten sections as follows: Automotive; Aircraft; Railroad; Watercraft; Structural; Furniture and Fixtures; Commercial Welding, Automotive Repair, and Welderies; Containers; Machinery; Jigs and Fixtures.

Needless to say, the book provides a tremendous volume of practical information on welding of value to scientific and technical schools, colleges and universities, engineering bodies and libraries, as well as industrial executives and officials. It should be of great value to designers, engineers, architects, production officials, and others desirous of obtaining the benefits of arc-welded construction.

THE ECONOMICS OF BUSINESS ENTERPRISE. By Walter Rautenstrauch. 445 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York. Price, $4.

This book is written with the aim of giving students of engineering instruction in the economics of business processes, particularly those processes in which their special skills will be engaged. The book is based on many years of experience in teaching, as well as in engineering and business. Many of the methods used to demonstrate the principles underlying the economics of business processes have been developed by the author in actual business situations in which he has been engaged.

The book deals primarily with some of the problems of the business unit and not with business as a whole. An idea of the subjects covered will be obtained from the following list of chapter headings: The Economic Cycle; The Principles of Estimating Costs; Methods of Cost Estimating; Interest and Depreciation; The Economic Worth of Machines, Materials, and Supplies; The Economic Characteristics of Business Enterprise; The Economic Characteristics of Typical American Businesses; The Interpretation of Financial Statements; and Business Enterprise on a National Scale.

FORGING HANDBOOK. By Waldemar Naujoks and Donald C. Fabel. 630 pages, 6 by 9 inches; 400 illustrations. Published by the American Society for Metals, 7016 Euclid Ave., Cleveland, Ohio. Price, $7.50.

This is the first book to cover the entire forging field, including design, processes, materials, tools and dies, new developments, etc. An idea of its scope will be obtained from a list of the twenty sections into which the text is divided: The Forging Industry; Forge Plant Equipment; Die Block and Process Operations Steels; Forge Dies and Tools; Forging Practice; Finishing Operations; Heat-Treatment of Forgings; Cleaning of Forgings; Testing and Inspection of Forgings; Materials Handling; Forge Plant Design; Forge Plant Maintenance; Furnaces and Furnace Design; Designing the Forged Part; Forging Materials; Job Estimating; Costs and Cost Engineering; Forge Shop Safety; Forging Definitions; and Mathematical Tables and Data. The material represents the practical experience of scores of manufacturers. Obviously, an authoritative book of so comprehensive a character should be of great value both to the buyer and user of forgings.

THE MICROSCOPE IN ELEMENTARY CAST IRON METALLURGY. By Roy M. Allen. 160 pages, 6 by 9 inches; 73 illustrations. Published by the American Foundrymen's Association, 222 W. Adams St., Chicago, Ill. Price, $3.

This book is an enlargement of material presented at a series of lectures before the 1939 convention of the American Foundrymen's Association in Cincinnati, Ohio. The book deals with the value of the microscope to the cast iron foundryman and the fundamentals of physical cast iron metallurgy. It is written in simple language that can be easily understood by the layman. The use of the microscope is explained, and instructions are given for securing, grinding, polishing, etching, observing, and photographing of the sample, together with an interpretation both of what is seen in the microscope and in the photomicrograph.

TOOLMAKING. By C. B. Cole. 413 pages, 5 1/2 by 8 1/2 inches; 475 illustrations. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Price, $3.50.

This is another of the so-called "How to Do It" series of books. It is intended for all those who are interested in toolmaking, and especially for beginners at this work. It describes the use of toolroom tools and equipment, heat-treating processes, and production methods and tools. Many actual working drawings are included. It tells, among other things, how to read a micrometer; how to use hardness testing machines; how to use Johansson gage-blocks; how to grind tools; how to operate a contour saw and file machine; how to do heat-treating; and how to make jigs, fixtures, and dies.

ALLOY CAST IRONS. 270 pages, 6 by 9 inches; 111 charts and illustrations. Published by the American Foundrymen's Association, 222 W. Adams St., Chicago, Ill. Price, $3.

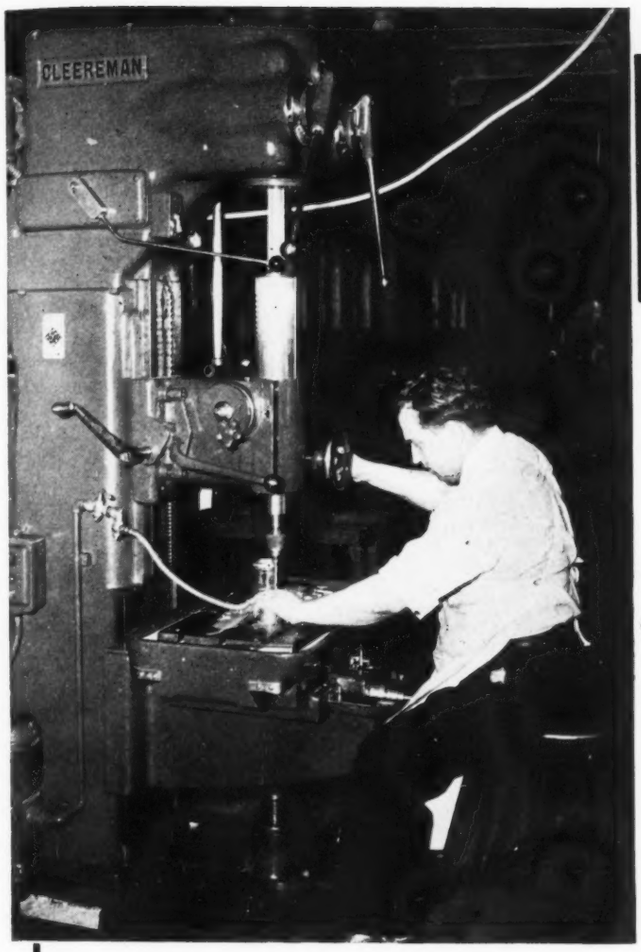
This book describes the effect of eighteen different elements on the properties of gray, white, and chilled cast irons. It also discusses the forms in which the alloying elements are available commercially and the different types that are added to various melting units. General foundry practice followed in the manufacture of alloy cast irons, including such subjects as melting, molding sands, heat-treatment, cleaning and finishing, etc., is described, and a chapter is devoted to the composition, mechanical properties, and uses of many types of alloy cast irons in commercial applications.

INDEX TO A.S.T.M. STANDARDS AND TENTATIVE STANDARDS. 140 pages, 6 by 9 inches. Published annually by the American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa. Copies are available without charge to anyone wishing to ascertain whether the Society has issued standard specifications, test methods, or definitions covering a particular engineering material or subject.

THE DISEASES OF ELECTRICAL MACHINERY. By G. W. Stubbings. 216 pages, 5 by 7 1/4 inches. Published by the Chemical Publishing Co., Inc., 148 Lafayette St., New York. Price, $3

This book is intended to serve as a text-book for electricians, apprentices, and power plant engineers. It describes the underlying causes of defects in electrical machinery and explains how to locate and correct these defects.

ELASTIC PROPERTIES OF CAST IRON. By Alexander I. Krynitsky and Charles M. Saeger, Jr. 17 pages, 6 by 9 inches. Published by the U. S. Department of Commerce, Washington, D. C., as Research Paper RP1176 of the National Bureau of Standards. Price, 15 cents.

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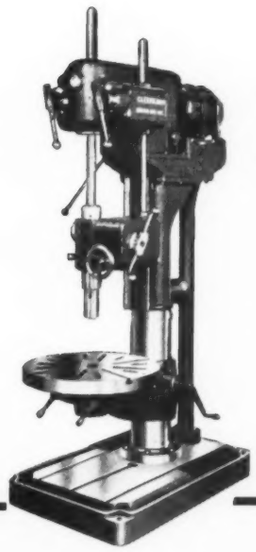
This new 25" CLEEREMAN DRILLING MACHINE is a valuable addition to the tool room in the Hill Shop of the Springfield Armory. Here we see it drilling a 5/16" hole in a steel forging at a spindle speed of 825 r.p.m.

CLEEREMAN DRILLING MACHINES are available in a standard range of sizes from 21" to 30" and in capacities up to 1 1/2" in S.A.E. 1035 steel. They are fast, accurate, convenient and pay for themselves through more and better work at lower cost.

Call in our engineers to analyze your drilling operations and to offer practical suggestions for handling your work at savings over your present methods.



**DRILLING MACHINES**

Fully geared — anti-friction—automatic lubrication—single lever feed and speed controls. No friction clutches. Round and box column types.

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Precision built for jig, fixture, tool and die work. Handle drilling, boring, reaming, tapping and light milling.

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# COMING EVENTS

JULY 10-14—Semi-annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at San Francisco, Calif. Clarence E. Davies, secretary, 29 W. 39th St., New York City.

AUGUST 30-SEPTEMBER 2 — Twenty-second INDUSTRIAL CONFERENCE, dealing with "Better Industrial Relations through Better Understanding" at Silver Bay, Lake George, N. Y. For further information, address Silver Bay Industrial Conference Committee, 347 Madison Ave., New York City.

SEPTEMBER 4-8—Fall meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at the Engineering Societies Bldg., 29 W. 39th St., New York City. Clarence E. Davies, secretary, 29 W. 39th St., New York City.

SEPTEMBER 20-22—Conference of the NATIONAL INDUSTRIAL ADVERTISERS ASSOCIATION, to be held at the Hotel New Yorker, New York City, under the sponsorship of the Technical Publicity Association of New York and the Industrial Marketers of New Jersey. For further information, communicate with William H. Easton, 420 Lexington Ave., New York City.

SEPTEMBER 28-29—Tractor meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Hotel Schroeder, Milwaukee, Wis. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

OCTOBER 4-13—NATIONAL MACHINE TOOL BUILDERS' EXPOSITION in Cleveland, Ohio. General Manager, Tell S. Berna, 10525 Carnegie Ave., Cleveland.

OCTOBER 5-7—National aircraft production meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Ambassador Hotel, Los Angeles, Calif. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

OCTOBER 15-21—Fortieth annual NATIONAL AUTOMOBILE SHOW, to be held at the Grand Central Palace, New York City. Further information can be obtained from the Automobile Manufacturers Association, General Motors Bldg., Detroit, Mich.

OCTOBER 16-20—NATIONAL SAFETY CONGRESS AND EXPOSITION in Atlantic City, N. J. For further information, address the National Safety Council, 20 N. Wacker Drive, Chicago, Ill.

OCTOBER 23-27—NATIONAL METAL EXPOSITION to be held in conjunction with the annual meeting of the AMERICAN SOCIETY FOR METALS in the International Amphitheater, Chicago, Ill. W. H. Eisenman, secretary, American Society for Metals, 7016 Euclid Ave., Cleveland, Ohio.

DECEMBER 4-9—Seventeenth EXPOSITION OF CHEMICAL INDUSTRIES in the Grand Central Palace, New York City. For further information, apply to Charles F. Roth, president of the International Exposition Co., Grand Central Palace, New York City.

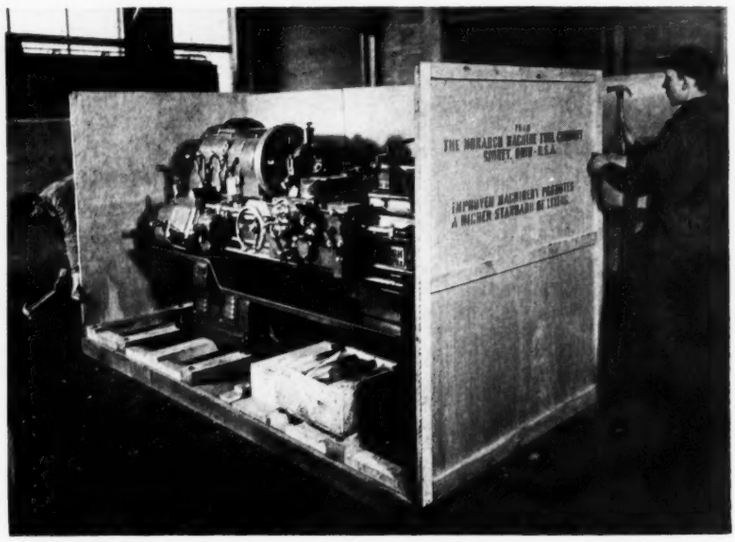
DECEMBER 4-8—Annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at the Bellevue-Stratford Hotel, Philadelphia, Pa. C. E. Davies, secretary, 29 W. 39th St., New York City.

JANUARY 15-19—Annual meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Book-Cadillac Hotel, Detroit, Mich. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

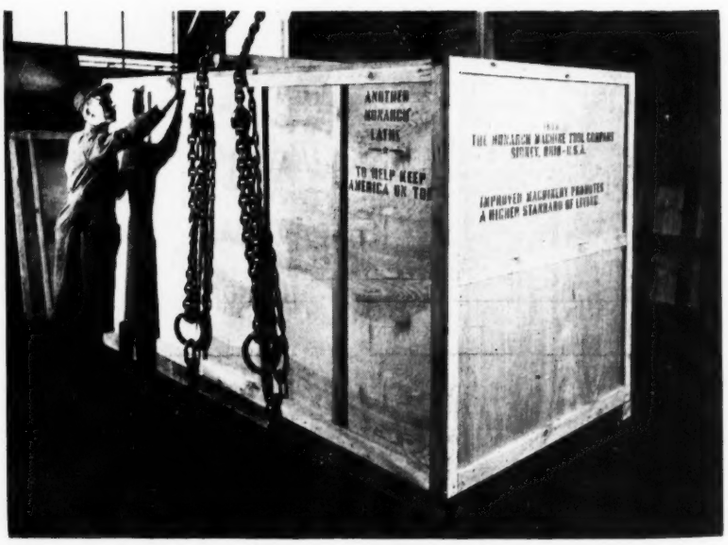
## New Method of Crating Machine Tools

Lathes manufactured by the Monarch Machine Tool Co., Sidney, Ohio, are now being shipped to domestic customers completely enclosed in plywood boxes instead of in the conventional open crates. This method prevents damage to the highly finished bright parts from dust, dirt, and cinders; these parts are, of course, protected as usual, by slushing compound or covered by waterproof wrappings.

On the boxes, advantage is taken of the opportunity to publicize the contribution of machinery to our industrial civilization, by stenciling such slogans as "Improved machinery promotes a higher standard of living," or "Another machine to make more goods for more people." The plywood sides and top of the box are built on the usual heavy hard wood skids.




Plywood Boxes Used for Crating Monarch Lathes




The Lathe Completely Enclosed, Ready for Shipment